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GLOSSARY OF TERMS AND ABBREVIATIONS

TERMS

Aircraft Identification	Up to seven alphanumeric characters, the first of which is alphabetic.
Air Route Traffic Control Center	The Government facility housing prime channel and DARC equipment from which en route air traffic control is exercised.
Central Computer Complex	The component of the prime channel which stores radar and other data; does initial filtering and formatting; furnishes data on request to CDC, DCC, and other operating units; provides aircraft tracking; and flight plan processing.
Computer Display Channel	The component of the prime channel which accepts data from CCC and, guided by requests from air traffic control sectors, processes, filters, and formats data, then presents the data on displays for use by air traffic control personnel in controlling air traffic.
Conformance	When the assigned altitude and the established altitude compare within adapted limits.
Control Processor	The control processor is a DARC processor responsible for loading programs and maps into the DP, and handling interfaces to the IOT, PVD R-controls, line printer, card reader, and status panels.
Display Channel Complex	The data control and processing system at some sites which duplicates the CDC capabilities using a larger data processor and CDC display components.

TERMS (Continued)

Display Control and Vector Generator	A module of the display generator unit. Each DCVG drives one plan view display.
Display Generator Unit	An equipment of the CDC and RDS housing six DCVGs and thus providing the data to six plan view displays.
Display Processor	A DARC processor responsible for processing radar inputs from the RMUX and formatting for data display on PVDs.
Data Receiver Group	A unit of the production common digitizer located at the ARTCC which receives digitized radar information from radar sites and supplies the prime channel and DARC with these data.
Established Altitude	The pressure corrected mode C reported altitude or pilot reported altitude used for the slant range correction of radar target data and in formatting full data blocks.
Full Data Block	A data block associated with either jurisdictional or nonjurisdictional tracks consisting of three lines of data with five fields, velocity vector, leader, and track position symbol. Display of each characteristic is selectable.
General Purpose Input Adapter	One type of CCC multiplexer channel adapter located in the PAM which interfaces CCC input data to external devices.
General Purpose Output Adapter	One type of CCC multiplexer channel adapter located in the PAM which interfaces CCC output data to external devices.

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General Purpose Output Adapter	One type of CCC multiplexer channel adapter located in the PAM which interfaces CCC output data to external devices.

TERMS (Continued)

Plan View Display	A unit which displays radar and map data on a cathode ray tube.
RTQC Processor	A DARC processor responsible for processing radar inputs from the RMUX and monitoring the quality of each radar source.
Remote Data Block	An FDB associated with a track that is not under jurisdictional control of the specified sector.
Remote Track	A nonjurisdictional track; i.e., a track not under the control of the specified sector; differs from the expression "track" which refers to both jurisdictional and nonjurisdictional tracks at the specified sector.
Radar Display Subsystem	The display components of the CDC used by the DCC.
Radar Multiplexer	A unit responsible for accepting data from up to 15 radars via DRGs and distributing this data on a serial bus to the DPs.
Refresh Output Controller	A subunit within a DARC DP that provides an interface to a DGU.
Systems Maintenance Monitor Console	A unit located at the ARTCC which receives and displays status and performance information from ARTCC equipment units and is used by the system engineer.
Supplementary Processing Board	A programmable subunit which may be incorporated into a DARC CP, DP, or QP in order to provide added processing capability.
System Status Console	A unit which interfaces the on-line CP with the available DPs, and the other CP with any remaining DPs for offline use. It also interfaces R-controls and peripherals to the appropriate CP.

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ABBREVIATIONS (Continued)

dB	Decibel
DBC	Discrete Beacon Code
dc	Direct Current
DCC	Display Channel Complex
DCI	DARC Console Interface
DCVG	Display Control and Vector Generator
DFK	Display Filter Key
DG	Display Generator
DGIO	Display Generator Input/Output
DGU	Display Generator Unit
DIO	Direct Input/Output
DIP	Dual Inline Package
DP	Display Processor
DRG	Data Receiver Group
DTD	DARC Timing Distribution
EEM	Electronic Equipment Modification
EOD	End of Data
EOM	End of Message
F	Fahrenheit
FAA	Federal Aviation Administration
FDB	Full Data Block
FDP	Flight Data Processing

ABBREVIATIONS (Continued)

dB	Decibel
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FDB	Full Data Block
FDP	Flight Data Processing

ABBREVIATIONS (Continued)

MTTR	Mean Time to Repair
NAS	National Airspace System
nmi	Nautical Mile
ns	Nanosecond
OP	Operation
OS	Operating System
par.	Paragraph
PCB	Printed Circuit Board
PCP	Primary Control Program
PDM	Program Description Manual
PVD	Plan View Display
QAK	Quick-Action Key
QP	Real Time Quality Control Processor
RAM	Random Access Memory
RCC	R-Controls Controller
R-Console	Radar Console
RCPO	Radar Collimation Printout
RDB	Remote Data Block
RDP	Radar Data Processing
RKM	Radar Keyboard Multiplexer

ABBREVIATIONS (Continued)

MTTR	Mean Time to Repair
NAS	National Airspace System
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FAA-STD-018 - Computer Software Quality Program Requirements.

FAA-STD-021 - Configuration Management (Contractor Requirements).

2.3 FAA PUBLICATIONS

Instruction Book, Computer Display Channel Radar Channel Equipment and Radar Display Subsystem Radar Keyboard Multiplexer - Type FA-7908 and Type FA-7909. (Available for use in the FAA Headquarters Building.)

Instruction Book, Computer Display Channel Radar Channel Equipment and Radar Display Subsystem R-controls and Monitor Controls - P/O Type FA-7912 and P/O Type FA-7940. (Available for use in the FAA Headquarters Building.)

NAS-MD-310 - Computer Program Functional Specifications, Introduction to Specification Series.

NAS-MD-311 - Computer Program Functional Specifications, Message Entry and Checking.

NAS-MD-314 - Computer Program Functional Specifications, Local Outputs.

NAS-MD-316 - Computer Program Functional Specifications, Adaptation.

NAS-MD-318 - Computer Program Functional Specifications, Performance Criteria.

NAS-MD-320 - Computer Program Functional Specifications, Multiple Radar Data Processing.

NAS-MD-321 - Computer Program Functional Specifications, Automatic Tracking.

NAS-MD-322 - Computer Program Functional Specifications, Real Time Quality Control of Radar Data.

NAS-MD-326 - Computer Program Functional Specifications, Adaptation Collection Guideline.

NAS-MD-740 - Interface Control Document, Direct Access Radar Channel (DARC), Display Generator (DG).

NAS-MD-741 - Interface Control Document, Direct Access Radar Channel (DARC), Central Computer Complex (CCC)/DARC Control Processor (CP).

NAS-MD-742 - Interface Control Document, Direct Access Radar Channel (DARC), Data Receiver Group (DRG)/DARC Radar Multiplexer.

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NAS-MD-318 - Computer Program Functional Specifications, Performance Criteria.

NAS-MD-320 - Computer Program Functional Specifications, Multiple Radar Data Processing.

NAS-MD-321 - Computer Program Functional Specifications, Automatic Tracking.

NAS-MD-322 - Computer Program Functional Specifications, Real Time Quality Control of Radar Data.

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NAS-MD-742 - Interface Control Document, Direct Access Radar Channel (DARC), Data Receiver Group (DRG)/DARC Radar Multiplexer.

MIL-STD-471 - Maintainability Verification/Demonstration/Evaluation.

MIL-STD-721 - Definition of Terms for System Effectiveness.

MIL-STD-756 - Reliability Prediction.

MIL-STD-461 - Electromagnetic Interference Characteristics Requirements for Equipment.

MIL-STD-781 - Reliability Tests, Exponential Distribution.

MIL-STD-785 - Reliability Programs for Systems and Equipment Development and Production.

MIL-STD-1130 - Connectors, Electrical, Solderless Wrapped.

2.6 MILITARY PUBLICATIONS

MIL-HDBK-217 - Reliability Stress and Failure Rate Data for Electronic Equipment.

2.7 FEDERAL STANDARDS

Federal Standard No. 595 - Colors.

2.8 INDUSTRY SPECIFICATIONS

NFPA No. 70 - National Electrical Code.

EIA Standard RS-232 - Interface Between Data Terminal Equipment and Data Communication Equipment Employing Serial Binary Data Interchange.

ASTM-B224 - Standard Classification of Coppers.

2.9 GENERAL INFORMATION

Copies of the applicable FAA specifications and drawings may be obtained from Federal Aviation Administration, Washington, D.C. 20591, Attn: Contracting Officer. Requests should fully identify material desired; i.e., specification numbers, dates, amendment numbers, complete drawing numbers; also, requests should identify the invitation for bids, request for proposals, or the contract involved, or other use to be made of the requested material.

Single copies of military specifications may be obtained from the Naval Supply Depot, 5801 Tabor Avenue, Philadelphia, Penn., 19120. Mail requests should cite the invitation for bids, request for proposals, or contract for which the specifications are needed.

Information on obtaining copies of Federal specifications and standards may be obtained from General Services Administration Offices in Washington, D. C.; Auburn, Washington; San Francisco, California; Denver, Colorado; Kansas City, Missouri; Atlanta, Georgia; Chicago, Illinois; New York, New York; Boston, Massachusetts; New Orleans, Louisiana; Fort Worth, Texas; and Los Angeles, California.

Information on obtaining copies of the National Electrical Code may be obtained from the National Fire Protection Association; 60 Batterymarch Street; Boston, Massachusetts 02110.

Copies of other publications referenced may be obtained from the Federal Aviation Administration, Washington, D. C. 20591, Attn: Contracting Officer. Requests should fully identify material desired; i.e., publication numbers, dates, etc., and use to be made of the requested material.

2.10 PRECEDENCE OF DOCUMENTS

This specification shall have precedence over all subsidiary documents referenced herein.

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Deliverable Items	Key Reference Paragraphs
C. Computer Programs	
1. Operational Programs	3.9.1
2. Support Programs	3.9.2
a. Utility System	3.9.2.1
(1) Assembler Programs	3.9.2.1.1
(2) Loaders	3.9.2.1.3
(3) Dumps	3.9.2.1.4
(4) Program Debugging Aids	3.9.2.1.5
(5) Compilers	3.9.2.1.2
b. Maintenance and Diagnostic Programs	3.9.2.2
3. Test Programs	3.9.3
D. Documentation	
1. System Documentation	3.11.1
a. Configuration Management	3.11.1.1
b. System Design Data	3.11.1.2
c. Qualification and Acceptance Test Plan	3.11.1.3
d. Equipment and Computer Program Test Procedures	3.11.1.4
e. Final Test Reports	3.11.1.5
f. Site Preparation Reports	3.11.1.6
g. Installation Documents	3.11.1.7
h. As-Built Installation Drawings	3.11.1.8
i. Interface Control Documents	3.11.1.9
j. System Instruction Manual	3.11.1.10

Deliverable Items	Key Reference Paragraphs
2. Hardware Documentation	3.11.2
a. Reliability and Maintainability Reports	3.11.2.1
b. Equipment Instruction Books	3.11.2.2
c. Index of Drawings and Technical Memoranda	3.11.2.3
d. Provisioning Technical Documentation	3.11.2.4
3. Software Documentation	3.11.3
a. Operational Program Documentation	3.11.3.1
(1) Program Description Manual	3.11.3.1.1
(2) Operator`s Manual	3.11.3.1.2
b. Support Program Documentation	3.11.3.2
(1) Assembler Reference Manual	3.11.3.2.1
(2) Assembler Operator`s Manual	3.11.3.2.2
(3) Utility System and Program Description Manual	3.11.3.2.3
(4) Programmer`s Reference Manual	3.11.3.2.4
(5) Maintenance and Diagnostic Program and User`s Manual	3.11.3.2.5
c. Test Program User`s Manual	3.11.3.3
E. Installation Materials and Cables	
1. Installation Materials	3.8.1
2. Installation Interconnecting Cables	3.8.2

Deliverable Items	Key Reference Paragraphs
2. Hardware Documentation	3.11.2
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c. Index of Drawings and Technical Memoranda	3.11.2.3
d. Provisioning Technical Documentation	3.11.2.4
3. Software Documentation	3.11.3
a. Operational Program Documentation	3.11.3.1
(1) Program Description Manual	3.11.3.1.1
(2) Operator`s Manual	3.11.3.1.2
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(2) Assembler Operator`s Manual	3.11.3.2.2
(3) Utility System and Program Description Manual	3.11.3.2.3
(4) Programmer`s Reference Manual	3.11.3.2.4
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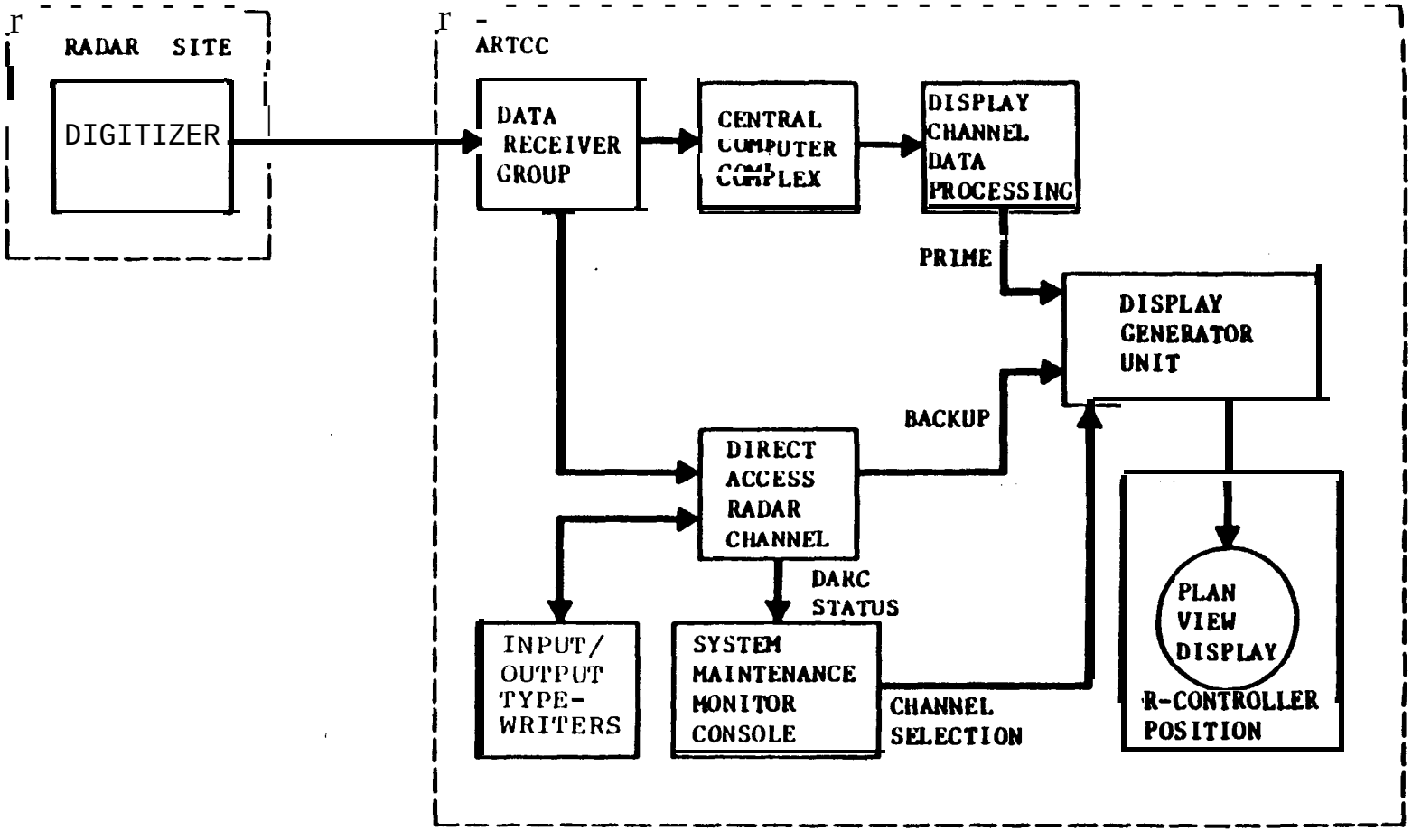

Figure 3-1. DARC Relationship to NAS En Route Stage A Prime Channel

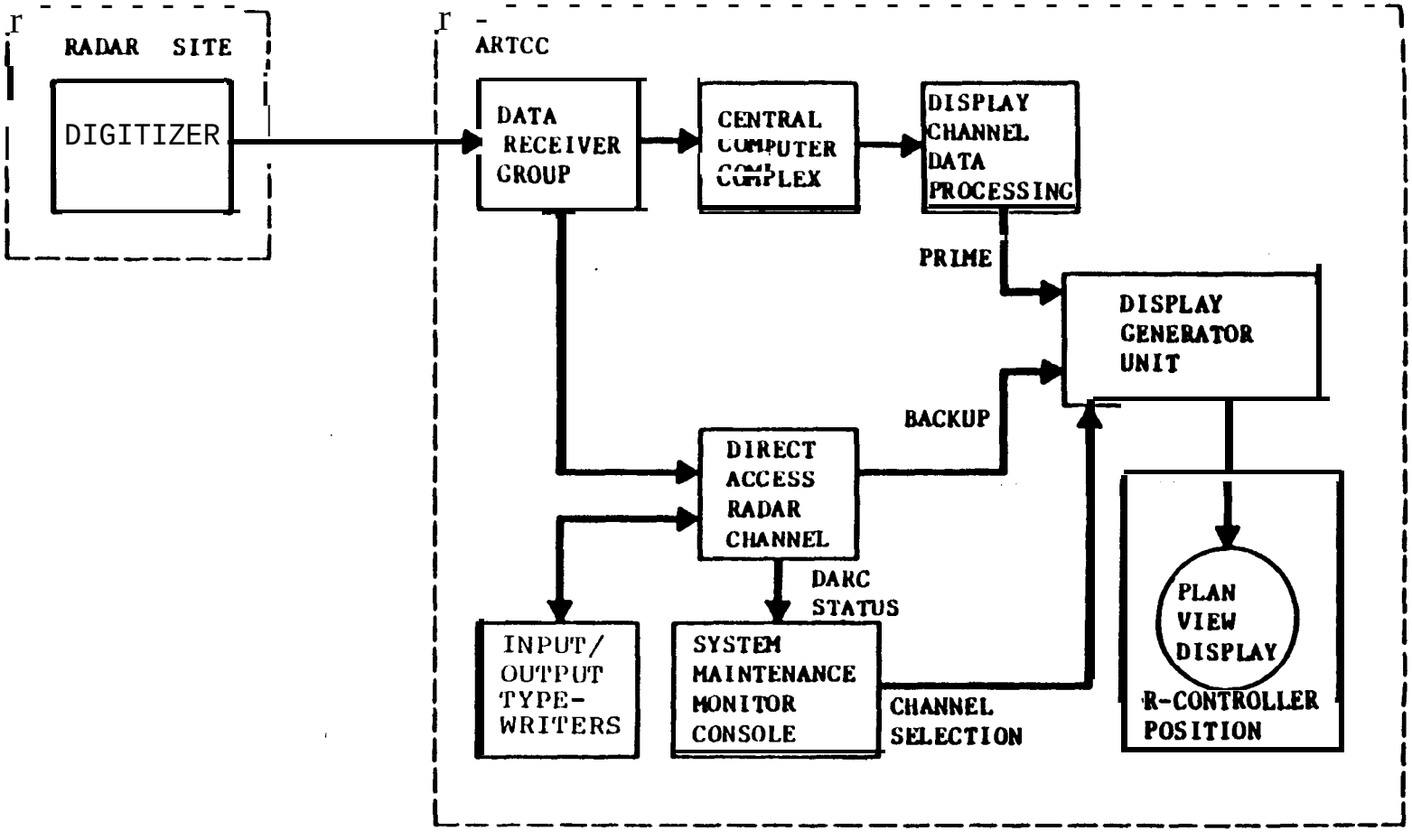

Figure 3-1. DARC Relationship to NAS En Route Stage A Prime Channel

There are three destinations for data necessary for the proper functioning of DARC:

a. The display generator unit, which transfers data to a PVD.

b. Peripheral equipment including magnetic read/write tape units and printers, which allow the monitoring and analysis of status and event occurrence.

c. The general purpose input (GPI), which transfers data from DARC into the prime channel.

3.2.1.1 Input/Output Peripheral Equipment.- Off-the-shelf peripheral input/output devices shall be provided to perform the following functions:

a. Store the operational, test, support programs, and program debugging aids for DARC.

b. Store site adaptation data consisting of PVD range scale, offcenter coordinates, radar pairing, and similar data.

c. Store up to 30 geographic maps, and up to 25 rho/theta target and weather filter sets, one set for each single-radar failure state plus one for the no-radar failed state.

d. Load the processor with stored data named in 3.2.1.1a, b, and c.

e. Receive contents of processor bulk and primary storage, registers, and accumulators, and produce hard-copy printout as required by the various programs and diagnostic procedures used with DARC. The operational program shall provide a printout device assignment table for all messages. All hard-copy printouts shall be time and day stamped in the format time/day. This format shall consist of four digits (the first two digits are hours and the second two digits are minutes) followed by a stroke character (/) and two digits representing day of the month.

f. Store the status of the system as well as other specified activities occurring throughout the system.

g. Store a single source mosaic map from which revised mosaic maps can be generated without interruption of system online operation in the event of radar input data failure. This map regeneration requirement shall apply to radar data failures associated with any combination or all radars assigned to the sort box(es) affected.

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a. The display generator unit, which transfers data to a PVD.

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channels from each DRG. Each channel supplies bit-serial data at 2,400 bits per second (bps). Each DRG shall interface with one radar site (three channels). The maximum number of DRGs per site is currently 15; however, all DARC software and all DARC display processor hardware shall be designed and provisioned to accommodate 24 radars per site. The display processor (DP) hardware shall be strap compatible with both the present 15-radar radar multiplexer (RMUX) and a Government furnished equipment (GFE) 24-radar RMUX of new design, given that the new design RMUX presents a DP interface in accordance with the appropriate interface control document (ICD) referenced in par. 2.3.

3.2.1.1.3 Radar Console Interface.- The DARC system shall receive and respond to data from the radar console (R-console). This capability permits each radar controller to initiate and terminate processing operations within the DARC systems that pertain to the R-console from which the data are entered. R-console data shall originate from a trackball and from keys and switches located on the system status and control panel, display filter control panel, field select control panel, quick-action/category select control panel, and alphanumeric keyboard.

The R-controls controller (RCC) section of the system status and control unit (SSC) shall interface a control processor with a maximum of 72 PVDs. The RCC shall interface the CP via the direct input/output (DIO) channel with a maximum of three radar keyboard multiplexers (RKMs). The RCC shall monitor operator keyboard actions and trackball movements, and shall update status and control indicators on the PVD. The RCC shall determine the settings of all two-position and rotary switches and shall determine the status of the console. Additional details regarding the radar console interface are contained in the appropriate ICD (see par. 2.3).

3.2.1.1.4 General Purpose Output.- DARC shall accept messages from the prime channel via the general purpose output device in accordance with the appropriate ICD (see par. 2.3). An eight-bit plus parity format shall be used for message format. Each message shall consist of an operation code followed by multiple data bytes. The message parity byte (checksum) shall provide a check on message integrity. The end-of-data (EOD) byte shall provide the message delimiter. When a transmission consists of a single message, the EOD byte shall be followed by a hardware end-of-message (EOM) transfer.

3.2.1.1.4.1 **Interface Levels.-** DARC shall provide two levels of interface between the CCC and DARC.

3.2.1.1.4.1.1 **Level A.-** DARC shall provide the function required to support the interface defined in the appropriate ICDs in par. 2.3.

3.2.1.1.4.1.2 **Level B.-** Messages from the prime channel (CCC) to DARC shall be divided into two categories: CCC type 1 and type 2. CCC type 1 shall be messages for which there are parallel R-control messages. CCC type 2 shall be messages for which there are no parallel R-control messages. Both types of messages shall be divided into directives and requests. DARC shall assume that directives are sent from the CCC after potential data base conflicts have been checked by the CCC. DARC shall assume that requests are sent from the CCC without the CCC checking for potential data base conflicts.

DARC shall process CCC type 1 directives and requests through their parallel R-control message processing paths and associated data base error detection logic. DARC shall process CCC type 2 directives and requests in accordance with the associated operation (op) code message.

3.2.1.1.4.2 GPO Error Detection and **Retransmission.-** DARC shall verify the status of each message received from the prime channel. When the received message is free of parity, checksum, and 9020 abnormal termination errors, DARC shall transmit a message acceptance indication on the GPO channel. When the received message contains one or more of these errors, DARC shall print a suitable error message and request retransmission of the batch. When retransmission requests exceed an adaptable limit within a 1-minute interval (GPXX), DARC shall print a suitable error message and change the operating mode to DARC (see par. 3.2.2.8 for DARC operating modes). The GPXX retransmission counter shall specify the number of GPO retransmission requests (0-10) per minute. When no message is received via the GPO within an adaptable period of time (GPOM), DARC shall print a suitable error message and change the operating mode to DARC. The GPOM parameter shall provide the message transmit/receipt frequency (1-127) in seconds. DARC shall subsequently check the received message for validity and, when applicable, capacity overflow. In the event that a message fails this check, DARC shall print a suitable error message, discard the message, and change the operating mode to DARC. Additionally, DARC shall transmit an acceptance or rejection message via the GPI interface to NAS on condition that the operating mode is DARC/flight data processing (FDP), and a message is entered at the D-position which requires disposition by DARC prior to unlocking of the keyboard. DARC shall not print a diagnostic error message in this case.

3.2.1.1.5 General **Purpose Input.-** DARC shall transmit messages to the prime channel via the general purpose input device. An eight-bit plus parity format shall be used for message format. Each message shall consist of an operation code, data bytes, parity byte, and message delimiter as described in par. 3.2.1.1.4.

Messages from DARC to the prime channel (CCC) shall be divided into two classes: type 1 and type 2. DARC type 1 messages shall be messages for which there are parallel R-control messages. DARC type 2 messages shall be messages for which there are no parallel R-control messages.

3.2.1.1.4.1.2 **Level B.-** Messages from the prime channel (CCC) to DARC shall be divided into two categories: CCC type 1 and type 2. CCC type 1 shall be messages for which there are parallel R-control messages. CCC type 2 shall be messages for which there are no parallel R-control messages. Both types of messages shall be divided into directives and requests. DARC shall assume that directives are sent from the CCC after potential data base conflicts have been checked by the CCC. DARC shall assume that requests are sent from the CCC without the CCC checking for potential data base conflicts.

DARC shall process CCC type 1 directives and requests through their parallel R-control message processing paths and associated data base error detection logic. DARC shall process CCC type 2 directives and requests in accordance with the associated operation (op) code message.

3.2.1.1.4.2 GPO Error Detection and **Retransmission.-** DARC shall verify the status of each message received from the prime channel. When the received message is free of parity, checksum, and 9020 abnormal termination errors, DARC shall transmit a message acceptance indication on the GPO channel. When the received message contains one or more of these errors, DARC shall print a suitable error message and request retransmission of the batch. When retransmission requests exceed an adaptable limit within a 1-minute interval (GPXX), DARC shall print a suitable error message and change the operating mode to DARC (see par. 3.2.2.8 for DARC operating modes). The GPXX retransmission counter shall specify the number of GPO retransmission requests (0-10) per minute. When no message is received via the GPO within an adaptable period of time (GPOM), DARC shall print a suitable error message and change the operating mode to DARC. The GPOM parameter shall provide the message transmit/receipt frequency (1-127) in seconds. DARC shall subsequently check the received message for validity and, when applicable, capacity overflow. In the event that a message fails this check, DARC shall print a suitable error message, discard the message, and change the operating mode to DARC. Additionally, DARC shall transmit an acceptance or rejection message via the GPI interface to NAS on condition that the operating mode is DARC/flight data processing (FDP), and a message is entered at the D-position which requires disposition by DARC prior to unlocking of the keyboard. DARC shall not print a diagnostic error message in this case.

3.2.1.1.5 **General Purpose Input.-** DARC shall transmit messages to the prime channel via the general purpose input device. An eight-bit plus parity format shall be used for message format. Each message shall consist of an operation code, data bytes, parity byte, and message delimiter as described in par. 3.2.1.1.4.

Messages from DARC to the prime channel (CCC) shall be divided into two classes: type 1 and type 2. DARC type 1 messages shall be messages for which there are parallel R-control messages. DARC type 2 messages shall be messages for which there are no parallel R-control messages.

be maintained at 55 hertz (+1, -0 Hz). When the quantity of display data requires more time than the 18.2 millisecond normal refresh frame the refresh rate shall be determined by the DCVG processing time.

The short persistence phosphor used in the plan view display cathode ray tube can exhibit variations in the brightness if the refresh time is not strictly controlled. To prevent noticeable brightness variations, the DARC systems shall be designed to provide refresh memory access priority for the PVDs. The design shall assure that each PVD shall be given access to the equivalent of two 64-bit messages, stored in refresh memory, once each 21.6 microseconds as specified above. Access times shall be assigned to PVDs on a fixed time slot basis to assure that variations in brightness due to access timing variations shall be held to an absolute minimum. When the PVD assigned to an access time slot is requesting access to refresh memory and its access time slot arrives, the access shall be given to that PVD. When the PVD assigned to an access time slot is not requesting access and its time slot arrives, the access shall be made available to the DARC data processor only and shall not be made available to other PVDs requesting access. Other PVDs requesting access shall be granted an access only during their assigned access time slot. Other refresh memory access priority schemes may be used provided that such schemes do not result in any noticeable brightness variations on any PVDs for any data load within the limits specified herein and that refresh memory access interference under worst case PVD and DARC processor access conditions do not result in a time difference of more than 108 microseconds between any two successive refresh time periods of the same display data. The refresh memory access priority scheme to be used shall be fully described.

3.2.1.1.7 Weather Processor.- DARC shall accept messages from the weather message switching unit processor via the DP-17 asynchronous channel multiplexer (ACM) port. The WMSU is a local microprocessor (Motorola MC-68000) unit which accepts weather data from the service A distribution network, provides filtering of extraneous data, and automatically passes to DARC the barometric pressure readings that shall be formatted into the AS altimeter message. The AS message shall contain an OP code followed by 12 bytes of American Standard Code for Information Interchange (ASCII) data and a checksum byte. DARC shall process the altimeter data, output any errors to the data entry keyboard/IOT, and update-the altimeter setting table.

3.2.2 Data Processing

The following paragraphs define the data processing functions to be performed by the DARC system.

3.2.2.1 Coordinate Systems.- Three coordinate systems are used in the prime channel. These coordinate systems shall be used by the DARC system input and output data processing operations.

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3.2.2.1 Coordinate Systems.- Three coordinate systems are used in the prime channel. These coordinate systems shall be used by the DARC system input and output data processing operations.

3.2.2.2.27 Flight List Location.- The location of the flight list on the display screen shall be adaptable. It shall be possible to change the location of the flight list for any PVD by a command entered from its R-console.

3.2.2.2.28 Preview Location.- The location of the preview area on the display screen shall be adaptable. It shall be possible to change the location of the preview area for any PVD by commands entered from its R-console.

3.2.2.2.29 R-Controls to PVD Pairings.- Each PVD is associated with a particular set of R-controls. These pairings shall be specified by adapted parameters.

3.2.2.2.30 Time of Day Location.- The location of the time of day display shall be adaptable. The DARC mode indicator and mode C intruder limits shall be displayed directly under the time of day.

3.2.2.3 Radar Target Position Processing.- The DARC system shall accept messages from the data receiver group in either four or seven field formats. Radar message formats are specified in the appropriate ICD (see par. 2.3). Only messages with good parity throughout and of the types specified in the ICD shall be processed; others shall be discarded. When excessive parity errors (count per unit time parameter) are received, an error report shall be printed. Processing of radar (search and beacon) target messages shall consist of: correcting range and azimuth data received from the DRG with adaptable constant parameters and additive RTQC parameters for each radar; determining on which displays the target shall appear; and formatting (with the correct symbol and display coordinate position) messages for the refresh image of each of the displays. All target data, excluding targets correlating with tracks associated with this PVD, shall be eligible for display on a particular PVD when the PVD and target message meet the following conditions.

a. The PVD is designated to receive that type of target message.

b. The target position coordinates fall within the geographic area and data filtering of the PVD.

3.2.2.3.1 Altitude Filtering.- The mode C intruder set of altitude filter limits shall be displayed continuously under the real-time clock display and may be changed from either the data entry keyboard or the R-console. A beacon target shall display a limited data block on a particular PVD if it is reporting a pressure-corrected mode C altitude that is within the mode C intruder altitude limits selected for the particular PVD. For mode C intruder altitude filtering purposes, an aircraft reporting an altitude greater than or equal to 60,000 feet shall be considered to have an invalid mode C report.

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Data shall be dropped at the end of the sixth scan interval, or sooner depending on history or filter key selection, following its receipt. A method of aging displayed target data from full brightness, denoting current position, to reduced brightness, denoting history position, shall be provided. The aging process shall cause target data to be removed from the display when its age equals the selected number of scans.

DARC shall batch together, for processing, all radar data received from one radar in an interval not exceeding 1.0 second duration. The age of a radar data batch shall nominally be changed each n seconds +0.1 second following receipt of the data batch where n is the integer radar scan time. The new to-be-displayed and old to-be-erased data batches, for a given PVD and given nominal radar scan time, shall be displayed or erased within a 0.3 second interval. This requirement, however, shall not apply to radar data that have correlated with a track, whether or not it remains correlated. Nominal scan times of 4.0 through 12.0 seconds shall be accommodated. Scan times are consistent between scans within plus or minus 0.1 second but may vary from nominal by up to 0.9 second. For a given ARTCC, radars may be of up to four different scan times which shall be defined by initialization data. Aging of radar data on the PVD shall be based on each radar's nominal scan time. Data blocks for tracked targets shall be updated at the tracker's update cycle. Data from up to 24 radars may be brought into each DP. DARC shall use the DP-to-radar pairing information in par. 3.2.2.2.10 to determine which radars it shall bring into each DP.

DARC shall use a multiple radar data processing (MRDP) function to process radar data. The MRDP function shall process digitized radar data received from the common digitizers once every second. A hierarchy for processing radar data shall be used in the MRDP function. This processing hierarchy shall prevent the loss of target data due to the processing of nontarget data at times when the radar data load exceeds specified design requirements. The MRDP function shall attempt to correlate the beacon and primary data with established tracks. If a track does not exist, the MRDP function shall attempt to automatically initiate tracks only on selected discrete beacon returns. If a parity error occurs in any message field, the message shall not be processed.

3.2.2.3.3 **Mode 3/A Code Processing.-** The DARC systems shall display mode 3/A beacon code data for those aircraft equipped with discrete (4096) code beacon transponders. The mode 3/A beacon code is part of the beacon target message input to the DARC from the DRG. It is a four-digit octal code transmitted by transponder-equipped aircraft. The mode 3/A code is provided in field 5 of the beacon message format.

3.2.2.3.4 **Registration and Collimation Error Adjustment.-** DARC shall provide for registration and collimation correction of range and azimuth target reports from the appropriate radar. The RTQC program shall provide periodic printouts of recommended error adjustment

factors. The beacon registration printout (BRPO) report shall detail both the recommended and currently applied range and azimuth corrections for the requested radar sites. The radar collimation printout (RCPO) report shall provide range and azimuth bias estimates of the search radar relative to the collocated beacon radar. These data shall be repeated for each of the requested radar sites. DARC shall use the radar/beacon parameter modification message (type ZM) to specify use of either the recommended factors or Systems Engineer (SE)-supplied factors. Beacon and primary radar messages shall be adjusted to compensate for the designated registration and collimation errors prior to rho/theta filtering.

3.2.2.3.5 Rho/Theta Filtering.- Rho/theta filtering shall be performed on primary and beacon target data using the received range and azimuth. The filtering shall be designed to discard messages that are not from the adapted preferred or supplementary sites of a radar sort box. The 360-degrees coverage of each radar shall be divided into 64 equal azimuth intervals called azimuth division areas (ADAs). Each ADA shall contain 64 azimuth change pulses. The azimuth of the radar datum shall be used to determine in which ADA the datum is located. Each ADA shall be assigned a minimum and maximum range (RTTF) stored in the rho/theta filter table to a precision not less than 1 nautical mile. The radar datum's range shall be compared to the RTTF values. Primary and beacon messages that fall outside of the RTTF boundaries shall be discarded.

3.2.2.3.6 Coordinate Conversion **and** Slant Range Correction.- The polar coordinates of radar data not discarded by the rho/theta filter shall be transformed into system X, Y coordinates by a first or second order approximation to the stereographic projection equations. The stereographic projection equations shall be developed for an axis system with its origin at the plane's point of tangency with the earth. The origin of the system cartesian axis system shall be located in the lower left-hand corner of the system plane. Radar data shall be transformed into system coordinates. The coordinates which result from this conversion are the system coordinates of the datum. Second order approximations to the stereographic projections shall be used when the range of the datum exceeds an initialized value for each site.

All radar data shall have a slant range correction applied as part of the conversion process. Beacon data with validated mode C shall be exact slant range corrected. The altitude used for exact slant range correction shall be the validated mode C data. Data which are exact slant range corrected during initial coordinate conversion shall be slant range corrected during the correlation process under the following conditions. During discrete correlation, a discrete beacon datum that contains validated mode C data shall be slant range corrected when its code matches the assigned discrete code of a track, the track contains an established altitude, and the mode C data are not in conformance with the established altitude. During standard correlation, a beacon datum that contains validated mode C data shall be

slant range corrected when it passes the primary search area check for a track, the track contains an established altitude, and the mode C data are not in conformance with the established altitude.

Data which are not exact slant range corrected during initial coordinate conversion shall be slant range corrected during the correlation process under the following conditions: (1) during discrete correlation, a discrete beacon datum that does not contain validated mode C data shall be corrected when its code matches the assigned discrete code of a track and the track contains an established altitude, and (2) during standard correlation, a datum that does not contain validated mode C data shall be corrected when it passes the primary search area check for a track and the track contains an established altitude.

3.2.2.3.7 Radar Sort Box Determination and **Mosaicing.-** The radar coverage area (projected onto the system plane) shall be divided into a 1,024 nmi square array of 16 nmi square boxes called radar sort boxes (RSBs). The radar sort box in which a radar datum lies is used in a selective rejection process called mosaicing. Mosaicing shall be performed using a site initialization table which designates one (or zero) source radar as preferred and one (or zero) as supplementary, for each unique sort box. Radar data shall be filtered on a radar sort box basis to eliminate data which lies outside of the radar sort box grid, to eliminate data which is neither preferred nor supplementary for a radar sort box, and to eliminate supplementary data which is not required. The radar mosaicing process shall employ an online generated mosaic map tailored to meet the current radar availability state, as specified in par. 3.2.1.1g. The adapted source mosaic map shall identify up to four preference-ordered radar sites per radar sort box. The online mosaic map generator shall utilize this source map, on occasion of either a systemwide program load or a change in radar availability state, to generate a current-radar-state-tailored mosaic map. This tailored map shall identify up to two radar sites per radar sort box.

The criteria for selecting the two (of a possible four) radar sites shall be availability, as defined by the current radar availability state, and preference level, as defined by the ordering of the radars (up to four) within the source mosaic map. The highest preference level radar site shall be utilized as the preferred radar for that radar sort box and the second highest shall be utilized as the corresponding supplementary radar. Additionally, the site initialization table shall define an optional stratification threshold altitude for each radar and shall designate the sort boxes for which stratification processing is required. In the event that the initially defined preferred radar for a given RSB is declared failed and the RSB is adapted as eligible for stratification processing, the stratification processing shall be disabled for that RSB; upon reinstatement of the radar, the stratification processing shall be reenabled. Radar data with validated mode C altitude and lying within one of the

designated sort boxes shall be filtered in accordance with the following rules:

a. Preferred returns with an altitude above or at the preferred radar threshold shall be discarded on the condition that stratification processing was adapted "on" for preferred returns within that sort box.

b. Supplementary returns with an altitude below the preferred radar threshold shall be passed on the condition that stratification processing was adapted "on" for preferred returns within that sort box.

The real time quality control processor (QP) shall disregard all adaptation requirements pertaining specifically to stratification processing.

In the event of a change in radar failure state, rho/theta filters and mosaic maps shall be replaced within the DP without temporary loss of normal radar processing functions. This requirement shall not preclude replacement of the filters and maps on an element-by-element basis. Mosaic maps shall be regenerated within the DP, on occasion of a change in radar-failure-state, without recourse to a download of mosaic map data from CP to DP (or to QP).

3.2.2.4 Mode C Altitude Processing.- Those beacon targets transmitting mode C altitude shall have such altitude displayed in either full or limited data blocks. Altitude information is transmitted as an 11-bit word with a least significant bit value of 100 feet. Negative altitudes are transmitted from the DRG in two's complement. A leading sign bit and trailing parity are also transmitted. An aircraft reporting a positive altitude greater than or equal to 60,000 feet shall be treated as follows:

a. When full data blocks have been selected for display they shall be displayed as specified in par. 3.2.2.12.1.

b. When limited data blocks have been selected for display (par. 3.2.2.12.2), the mode C value displayed shall be 600.

Negative altitudes, or altitudes which differ from the radar site elevation by more than the slant range reported by the radar site, or if not validated by the common digitizer (CD), are unvalidated and shall not be used for slant range correction or display purposes. Additionally, the radar target datum shall not be used for registration analysis. Otherwise, the altitudes are considered validated and shall be utilized accordingly, including for display purposes as specified in par. 3.2.2.12. Mode C information shall normally be received every radar scan from beacon targets so equipped. Altitude data shall be displayed for one radar scan interval following the receipt of the data and then discarded.

Mode C altitude as received from an aircraft shall be corrected for local barometric pressure in accordance with the following procedure. Corrections shall be made only to reported altitudes below a given level; the level varies with sea level barometric pressure and shall be 18,000 feet for reported sea level barometric pressure of 29.92 inches of mercury (Hg) or more. The level below which corrections shall be made for sea level pressures lower than 29.92 inches Hg shall be as follows:

Reported Altimeter Setting, Inches of Mercury	Reported Mode C Level At Which Correction Is Required (Feet)
29.92 or more	18,000
29.42 - 29.91	18,500
28.92 - 29.41	19,000
28.42 - 28.91	19,500
27.92 - 28.41	20,000
27.91 and lower	20,500

A table shall be maintained in processor memory for the current altimeter setting and observation time from each reporting point; there shall be up to 100 reporting points. Updating shall be made as required, either automatically via the interface specified in par. 3.2.1.1.7, or via an altimeter setting (AS) message. A table shall also be maintained relating each radar sort box to an altimeter reporting point. The correction routine shall be entered when mode C altitude, as received, is 300 feet or more below the stated level at which correction is required. A pressure correction factor shall be calculated for each altimeter setting reporting point as follows:

$$\text{Delta } H = (B - 29.92) \times 925 \text{ (rounded to nearest 100 feet)}$$

Where: Delta H = Mode C correction factor for the reporting station and its associated sectors.

B = Barometric pressure corrected to mean sea level of the reporting station expressed in inches of mercury.

The altitude value displayed by DARC shall be the mode C value received plus delta H wherever correction is required, and the value received where correction is not required. The processor shall output, to refresh memory, the three altitude characters and shall insure that these characters are positioned properly in relation to the radar target symbol.

3.2.2.5 Geographic Map Processing.- DARC shall display a geographic map on each PVD, which DARC shall derive from a system map input supplied by the Government in system coordinates. This system map input shall be the current facility ACES output. Maps consist of lines

and symbols representing the airway structure, navigational aids, airports, obstructions to air traffic, and similar items necessary to the air traffic controller. A minimum peripheral storage allocation, equivalent to 4,160 words of 16 bits each, shall be provided for each of 30 disk-resident maps. Based upon initialization data, the DARC processor shall obtain the correct map input from peripheral data storage. For each map, the data shall be stored in system coordinates and organized into four categories corresponding to the map display filter keys (pars. 3.2.2.11.1c through 3.2.2.11.1f). The map data (class types 42, 43, 44, 45, and 50) to be associated with each display filter key (DFK) shall be site adaptable and specified for the map assembler (see par. 3.9.2.1.2).

Based upon the PVD range scale, PVD center parameters, and four display filter keys, the processor shall filter the map to eliminate data outside the PVD viewing area and convert the data for the DGU using formats specified in the appropriate ICD (see par. 2.3). All lines, including both weather and geographic, extending off the PVD screen; i.e., lines which have either or both endpoints located outside the PVD display area, shall be truncated. Truncation shall be accomplished such that the endpoint(s) which are changed shall fall on a circle whose radius is equal to the radius of the display plus or minus 4 percent of the display radius.

DARC shall provide for three distinct forms of map modification as follows:

a. **Map Key Selection Change.-** DARC shall provide four DFKs for the selection of different types and classes of map data. A request for increased map information via a DFK shall not cause the deletion of previously selected map data. A request for decreased map information via a DFK shall not cause the deletion of map data requested via other DFKs.

b. **PVD Range/Center Change.-** DARC shall effect a range/center change in the following order:

   1. Store the displayable portion of the new map in its entirety within refresh memory.

   2. Clear all data except for list data, preview area, trackball cursor, and banner (par. 3.2.2.2.30) from the display.

   3. Display the new map.

   4. Position the full data blocks at their new display locations.

   5. Rebuild the radar data image.

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   3. Display the new map.

   4. Position the full data blocks at their new display locations.

   5. Rebuild the radar data image.

radars are tied-off. In the event that more than two radar sites are tied-off or that a radar site is partially tied-off; e.g., beacon data systemwide or all data at selected DPs, DARC shall not alter the current radar data filters unless directed to via a YS override. In the case of such override, DARC shall be precluded from making further radar data filtering adjustments until such time as the override is retracted via a suitable YS entry.

Radars which have been wholly tied-off from one or more processors shall be excluded from all RTQC analyses at the affected processors; radars which have had beacons and/or primaries tied-off at the QP shall be excluded from registration and collimation analyses; all other RTQC analyses shall occur independent of surveillance tie-off requirements.

3.2.2.6.2 Altimeter Reporting Station Data **Printouts.-** It shall be possible, by a command entered at an IOT to print on the IOT or line printer, the barometric pressure and time of observation for a single, multiple, or all, altimeter reporting station(s).

3.2.2.6.3 Combining/Decombining of **Sectors.-** The DARC system shall provide the capability to combine and decombine DARC-controlled sectors and sector tracking rectangles by using the resector/R-position assignment (CS) message and the sector to PVD pairing report (SPPR). The CS message shall provide the capability to establish one of three sector plan data bases and to establish the sectors assigned to a PVD. The SPPR shall provide information concerning the relationship between physical PVDs and the logical numbering of sectors. A combining action shall cause DARC to merge one or more sectors with a current sector and to form a corresponding STR. A decombining action shall cause DARC to reestablish the prior airspace assignments. When sectors are combined, a single sector shall be designated as the controlling sector and shall serve as the sector identification label for all transactions. When STRs are combined, the boundaries of the resulting STR shall be as defined by the extremities of the combining STRs. Following a combining or decombining action, all tracks (including remote data blocks) and flight list entries shall remain at the prior PVDs until repositioned by R-controller input. DARC shall ensure that sector-oriented data messages are routed to the designated active sector position at all times.

3.2.2.7 DGU **Reset Command.-** Any time DARC departs from its normal mode of operation, DARC shall send a reset command to all DGUs upon subsequent restoral to normal operation. The DGU reset signal resets the DCVGs to their initialized states preparatory to receiving data and commands via the DARC input to the display generator input/output (DGIO) assembly. Additional characteristics of the DGU reset signal are specified in the appropriate ICD (see par. 2.3). The DARC system shall also initiate a DGU reset command when requested from an IOT.

3.2.2.8 DARC Operational States.- The DARC system shall provide two selectable levels of operation. The levels shall be designed to accommodate the existing 9020 to DARC interface configuration and the expanded communication configuration resulting from enhancements to DARC. Within each level there shall be three selectable modes of operation. The modes shall be designed to accommodate system configurations for flight data processing, radar data processing, and standalone DARC.

3.2.2.8.1 Modes.- The modes of DARC operation shall be as follows:

a. **DARC/NAS.-** DARC shall operate as an RDP backup to the 9020 FDP/RDP system.

b. **DARC/FDP.-** DARC shall perform RDP functions in concert with the 9020. The 9020 shall be operating in surveillance tie-off and, accordingly, performing FDP functions only.

c. **DARC.-** DARC shall operate as an autonomous system. All functions shall be performed independent of 9020 operation.

3.2.2.8.2 Levels.- The levels of DARC operation shall be as follows:

a. **Level A.-** The 9020 shall transmit flight data to DARC by means of a unidirectional communications path.

b. **Level B.-** The 9020 and DARC shall exchange flight and track data via a bidirectional communications path. D- and R-control inputs shall be remoted as required from the receiving system; i.e., the 9020 or DARC, to the system tasked with processing the requested action.

3.2.2.8.3 Indication of Mode Transition.- Following transition to a new mode, DARC shall display the new mode in the DARC banner and print a suitable message on a hard-copy device. The hard-copy device shall be dynamically adaptable. When the hard-copy device is an IOT, the IOT bell shall be activated.

3.2.2.8.4 DARC Mode Transitions.- Mode transitions to or from DARC mode shall be accomplished at any time. The three distinct forms listed below are described in the paragraphs that follow.

a. Automatic transition when an adapted number of errors has occurred on the DARC-9020 interface.

b. Directed transition without startup or download.

c. Directed transition with a startup or download.

3.2.2.8.4.1 Automatic Mode Transitions.- Automatic mode transitions shall be limited to transitions to DARC mode. At such time, the GPO and GPI interface between DARC and the 9020 shall be configured unavailable by DARC.

3.2.2.8.4.2 Directed Mode Transitions Without Startup.- The following mode transitions without startup shall be provided.

3.2.2.8.4.2.1 Level A.- All mode transitions in level A shall be without a startup sequence. Existing tracks and jurisdictional control in effect at the time of transition shall remain in effect until such time as a clear flight data message is received from the 9020. Mode transition directives shall be initiated at a DARC IOT. The following transitions shall be valid:

a. DARC to DARC/FDP.

b. DARC/FDP to DARC.

c. DARC/NAS to DARC.

d. DARC/NAS to DARC/FDP.

3.2.2.8.4.2.2 Level B.- At the time of transition, DARC shall begin processing in DARC mode. The GPO and GPI shall be configured unavailable. The following DARC IOT-directed transitions shall be valid:..

a. DARC/FDP to DARC.

b. DARC/NAS to DARC.

The following 9020 directed mode transitions shall be valid:

a. DARC to DARC/FDP.

b. DARC to DARC/NAS.

c. DARC/FDP to DARC.

d. DARC/FDP to DARC/NAS.

e. DARC/NAS to DARC.

f. DARC/NAS to DARC/FDP.

3.2.2.8.4.3 Directed Mode Transitions With Startup.-

3.2.2.8.4.3.1 Level A.- No startup mode processing shall be required in level A transitions.

3.2.2.8.4.1 Automatic Mode Transitions.- Automatic mode transitions shall be limited to transitions to DARC mode. At such time, the GPO and GPI interface between DARC and the 9020 shall be configured unavailable by DARC.

3.2.2.8.4.2 Directed Mode Transitions Without Startup.- The following mode transitions without startup shall be provided.

3.2.2.8.4.2.1 Level A.- All mode transitions in level A shall be without a startup sequence. Existing tracks and jurisdictional control in effect at the time of transition shall remain in effect until such time as a clear flight data message is received from the 9020. Mode transition directives shall be initiated at a DARC IOT. The following transitions shall be valid:

a. DARC to DARC/FDP.

b. DARC/FDP to DARC.

c. DARC/NAS to DARC.

d. DARC/NAS to DARC/FDP.

3.2.2.8.4.2.2 Level B.- At the time of transition, DARC shall begin processing in DARC mode. The GPO and GPI shall be configured unavailable. The following DARC IOT-directed transitions shall be valid:.

a. DARC/FDP to DARC.

b. DARC/NAS to DARC.

The following 9020 directed mode transitions shall be valid:

a. DARC to DARC/FDP.

b. DARC to DARC/NAS.

c. DARC/FDP to DARC.

d. DARC/FDP to DARC/NAS.

e. DARC/NAS to DARC.

f. DARC/NAS to DARC/FDP.

3.2.2.8.4.3 Directed Mode Transitions With Startup.-

3.2.2.8.4.3.1 Level A.- No startup mode processing shall be required in level A transitions.

b. The DP is operating at maximum track capacity.

c. The aircraft identification (AID) of the target matches the AID of a target having track storage in the system.

3.2.2.9.2 **Automatic Track Initiation, the Flight List, and the Hold List.-** A record of the pairing of aircraft identification, beacon code or primary indicator, assigned altitude (optional), computer identification (CID), and sector assignment, as entered from either the PVD's R-controls or the 9020 GPO, shall be maintained for each PVD. This record, called a flight list, shall be used to automatically initiate tracks on discrete beacon-equipped aircraft. Tracks shall be automatically initiated at a PVD on condition that:

a. The discrete beacon code of the radar datum is contained in the PVD's flight list.

b. The PVD's sector tracking rectangle contains the radar datum position.

c. The automatic track initiation function is enabled.

d. DARC is not operating in level B DARC/NAS mode.

e. Less than 150 aircraft are tracked at the subject DP.

f. The AID of the radar datum is unique among entries currently maintaining track storage.

g. The radar datum is not in the flight list as a result of a drop track only action.

An entry shall be removed from the flight list upon: (1) receipt of a delete message; (2) manual or automatic initiation of the track or: (3) in DARC mode levels A and B, expiration of a parameter-controlled period of inactivity. A list entry shall be updated on receipt of an appropriate update message. Discrete beacon code tracks placed in the hold mode by the R-controller shall be temporarily retained in the hold list for use in automatic track initiation when the hold is released. When a track is placed in the hold mode, DARC shall terminate tracking but retain track storage. It shall be possible to disable the automatic track initiation function, via IOT input, without affecting the contents of either the flight or hold lists; disablement shall preclude automatic track initiation of flight-listed aircraft. A master flight list containing the associations for all PVDs shall be maintained for the entire system within the CP subsystem. The list shall be sized to accommodate 1,500 entries.

Each DARC DP shall accommodate 270 flights of which a maximum of 150 (186 in DARC/NAS level A) may be active and a maximum of 270 may be inactive. Active tracks consist of tracks in present position hold,

tracks that are in coast, and tracks that are subject to update via correlated target reports. Inactive tracks consist of listed flights that are not active flights. The maximum quantity of present position holds shall be 50 per PVD.

3.2.2.9.3 Track Termination.- Tracks shall be terminated within a DP whenever one of the following conditions exists:

a. The predicted track position passes beyond the RSB grid or has no adapted radar coverage.

b. The track enters hold status.

c. The track merit designator (TMD) is set to UNRELIABLE and the TMI is set to FREE COAST for more than the track termination interval parameter.

d. A track coast directive is received from the prime channel.

e. A cancel track action is initiated (either a drop track only or a remove strip action).

f. The track is predicted into an RSB with no adapted radar coverage.

g. The track is handoff-accepted by a PVD driven by a second DP and the required timeout interval parameter has elapsed.

h. A request/suppress data block action is taken on a remote data block whose corresponding remote track is being maintained solely to support the display of the remote data block.

i. The track ceases to provide useful registration data (QP only).

j. A remove strip directive is received from the prime channel.

k. A track hold/release directive is received from the prime channel.

3.2.2.9.4 Track Position Symbols.- Correlated tracks are displayed at the correlated position and shall be updated at least every tracking cycle. The coast tracking symbol shall be displayed at the tracker predicted position when the track is in coast.

3.2.2.9.5 Correlation.- DARC shall use the multiple radar data processing (MRDP) function to correlate radar data with all tracks except those tracks which are in hold status or in the free coast mode. Each target radar datum that has passed selective rejection shall either be correlated with a track, used to initiate a new track,

tracks that are in coast, and tracks that are subject to update via correlated target reports. Inactive tracks consist of listed flights that are not active flights. The maximum quantity of present position holds shall be 50 per PVD.

3.2.2.9.3 Track Termination.- Tracks shall be terminated within a DP whenever one of the following conditions exists:

a. The predicted track position passes beyond the RSB grid or has no adapted radar coverage.

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d. A track coast directive is received from the prime channel.

e. A cancel track action is initiated (either a drop track only or a remove strip action).

f. The track is predicted into an RSB with no adapted radar coverage.

g. The track is handoff-accepted by a PVD driven by a second DP and the required timeout interval parameter has elapsed.

h. A request/suppress data block action is taken on a remote data block whose corresponding remote track is being maintained solely to support the display of the remote data block.

i. The track ceases to provide useful registration data (QP only).

j. A remove strip directive is received from the prime channel.

k. A track hold/release directive is received from the prime channel.

3.2.2.9.4 Track Position Symbols.- Correlated tracks are displayed at the correlated position and shall be updated at least every tracking cycle. The coast tracking symbol shall be displayed at the tracker predicted position when the track is in coast.

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track table entry, as initialized via a track initiate based on current track data, as updated by the transfer of assigned code, assigned altitude, interim altitude, reported altitude, AID changes from the CP, and as otherwise maintained by the local tracker. DARC shall bypass the track initiation action whenever the identified track is currently tracked at the receiving DP. DARC shall place the remote data block track in hold status, without a corresponding hold list entry, when the jurisdictional track is placed in hold. DARC shall remove the remote data block track from hold status when the jurisdictional track is removed from hold status, and drop the track, if primary or nondiscrete, or subject the track to normal discrete correlation and track maintenance rates, if discrete. DARC shall also drop the remote data block track, without corresponding flight list entry, when the jurisdictional track is dropped or terminated. DARC shall place the remote data block track in flight coast, when so directed by the 9020. All remote data block fields shall be displayed regardless of mode C filtering, beacon code list filtering, nonmode C filtering, and field select key positions.

All remote data block tracks shall be governed by the same requirements as jurisdictional tracks with the following exceptions:

a. The track initiation restriction specified in paragraph 3.2.2.9.1a shall not apply.

b. The track initiation restriction specified in paragraph 3.2.2.9.1c shall not apply.

c. The track shall not be maintained as a separate entry in the central track file, nor be counted among the 700 track entries specified in par. 3.2.2.9.2, nor be subject to system analysis recording (SAR).

d. The track shall be deleted when no longer required to maintain a remote data block display for any PVD on the subject DP.

e. The track and associated remote data block shall be subject to the following quick-action key messages entered at the receiving PVD: (1) data block offset, (2) forced data block and suppress/request data block messages used expressly to delete the subject RDB, and (3) handoff accept, in which case the RDB is replaced with an FDB. All other quick-action messages entered at the receiving PVD, except as provided for by direct alteration of the source track, shall be rejected.

f. Search and nondiscrete RDBs shall be automatically deleted following an adapted timeout interval.

3.2.2.10 Weather Processing.- DARC shall accept weather map messages with good parity from the three output channels of all paired DRGs. The common digitizer operates in conjunction with the weather fixed map unit (WFMU) to produce range start and stop values and azimuth bearing for the two levels of weather intensity. Three radar scans are required to complete transmission of either the high or low intensity weather map data. Since other map messages are interleaved with the weather map messages, a total of 12 antenna scans are necessary to update all weather information. Each type of map message is transmitted for one complete radar scan in the following sequence of scans:

N H S H N H S L N L S L

Where: N = Normal map
H = High intensity weather map
S = Sensitive map
L = Low intensity weather map

Only high and low intensity weather map messages shall be processed. The DRG map message format contains three bits to identify the type of map message. These bits are encoded as follows:

	Message Type	Bit 8	Bit 9	Bit 10
N	Normal Map	0	1	0
H	High Intensity Weather Map	1	0	1
S	Sensitive Map	0	0	1
L	Low Intensity Weather Map	1	1	0

Weather messages are reported at discrete azimuth intervals depending on messages types (high or low intensity) and WFMU resolution settings. Approximately one-third of the weather data (high or low intensity) are transmitted during each of the three scans which are required to complete transmission of data for either intensity outline. Details of the interface between DARC and the DRG are specified in the appropriate ICD (see par. 2.3). DARC shall process each message and place the appropriate data in the refresh memory image for each plan view display that should display the weather message. To be eligible for display, the following conditions must be met by the display and the message:

a. The PVD is paired to a DP that is paired to the radar from which the message was received.

b. The display selection parameters are set to select the type of weather message (high or low intensity, or both).

c. A portion of the weather message line falls within the geographic area covered by the display, based upon the display's range scale and offcenter parameters.

If a low intensity weather message is eligible for display, a reduced brightness line message shall be formatted with display coordinates for the line defined by the weather message and placed in the refresh memory for the PVD. Lines extending off the PVD shall be truncated as specified in par. 3.2.2.5. For a high intensity weather message that is eligible for display, two symbols shall be placed into the refresh memory for the proper PVD at positions corresponding to the line endpoints of the weather message. A small, reduced brightness "H" shall be the symbol used. When one of the two line endpoints falls outside the display coordinate grid, the corresponding symbol shall not be placed into the refresh memory. Weather data may be processed in batches with each batch consisting of the weather data received by DARC in a period up to one-half of the nominal antenna scan time.

DARC shall provide storage for weather messages received within the last 144 seconds cycle in order to support the 6-second rebuild requirement. The storage shall accommodate 2,000 weather messages and shall be maintained on a first-in, first-out basis.

3.2.2.11 Radar Console Processing.- The DARC system shall provide R-control messages in the identical format as the prime channel to the extent specified in this section.

3.2.2.11.1 Display Filter Keys.- DARC shall provide display filter key functions as listed below. There are 28 display filter keys arranged in four columns with seven rows on the PVD. These backlighted, alternate action keys shall be used to select or inhibit data for display on the PVD.

a. **Weather I.-** Low intensity weather lines (see par. 3.2.2.10).

b. **Weather II.-** High intensity weather single symbols (see par. 3.2.2.10).

c. **Strobe Lines.-** Strobe lines (see par. 3.2.2.15).

d. **Map I.-** Airways and geographic single symbols (see par. 3.2.2.5).

e. **Map II.-** Additional airways (see par. 3.2.2.5).

f. **Sector Boundaries.-** Sector and center boundaries (see par. 3.2.2.5).

g. **Special Areas.-** Warning areas, restricted areas, climb corridors, and any other special areas (see par. 3.2.2.5).

c. A portion of the weather message line falls within the geographic area covered by the display, based upon the display's range scale and offcenter parameters.

If a low intensity weather message is eligible for display, a reduced brightness line message shall be formatted with display coordinates for the line defined by the weather message and placed in the refresh memory for the PVD. Lines extending off the PVD shall be truncated as specified in par. 3.2.2.5. For a high intensity weather message that is eligible for display, two symbols shall be placed into the refresh memory for the proper PVD at positions corresponding to the line endpoints of the weather message. A small, reduced brightness "H" shall be the symbol used. When one of the two line endpoints falls outside the display coordinate grid, the corresponding symbol shall not be placed into the refresh memory. Weather data may be processed in batches with each batch consisting of the weather data received by DARC in a period up to one-half of the nominal antenna scan time.

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f. **Sector Boundaries.-** Sector and center boundaries (see par. 3.2.2.5).

g. **Special Areas.-** Warning areas, restricted areas, climb corridors, and any other special areas (see par. 3.2.2.5).

u. **ALT5.-** Uncorrelated mode C beacon target symbol data between and including ALT4 plus 100 feet and ALT5. If the value 165 were adapted for this key, it could be labelled "136 - 165" (see par. 3.2.2.3).

v. **ALT6.-** Uncorrelated mode C beacon target symbol data between and including ALT5 plus 100 feet and ALT6. If the value 205 were adapted for this key, it could be labelled "166 - 205" (see par. 3.2.2.3).

w. **ALT7.-** Uncorrelated mode C beacon target symbol data between and including ALT6 plus 100 feet and ALT7. If the value 239 were adapted for this key, it could be labelled "206 - 239" (see par. 3.2.2.3).

x. **ALT8.-** Uncorrelated mode C beacon target symbol data between and including ALT7 plus 100 feet and ALT8. If the value 999 were adapted for this key, it could be labelled "240 - 999" (see par. 3.2.2.3).

3.2.2.11.2 Quick-Action Keys.- There are 15 backlighted quick-action keys (QAKs) located on the R-console. Quick-action keys shall be used for composing messages that direct the computer to initiate, change, or terminate an operation, or to respond to a specific display request. All of the messages assigned to the same key number shall be considered a message type. The QAK number to message type assignment shall be adaptable. There shall be 16 message types, one for each of the 15 QAKs and one for the none condition (when no QAK key is depressed). DARC shall process messages associated with 11 of the message types.

There shall be four ways to identify aircraft which are currently tracked or contained in either the flight or hold list. The general term for all four cases shall be "flight identification" (FLID). When used in the context of quick-action message entry format, FLID shall imply depression of the appropriate enter key; i.e., trackball ENTER for trackball capture (TBC) and keyboard ENTER for discrete beacon code (DBC), CID, and AID. FLID shall be established as follows:

a. **Trackball Capture (TBC).-** It shall be possible to identify an aircraft by placing the trackball cursor over the track or list entry of interest. DARC shall perform a fixed-dimension square proximity check between the cursor and the lead character of each flight and hold list entry. If no entry is found, DARC shall perform a square proximity check between the cursor and the predicted position within the appropriate track file. The size of the square used for the latter proximity check shall be adaptable. DARC shall return an error message when no track is identified via either search.

b. Discrete Beacon Code (DBC).- It shall be possible to identify an aircraft by way of its four-digit, assigned, discrete, octal beacon code.

c. Computer Identification (CID).- When the CIDS parameter is in the on state it shall be possible to identify an aircraft by way of a three-digit, computer-assigned code. These codes shall be assigned by DARC or the prime channel according to the mode of operation. The first two digits of the code shall be decimal numbers in all cases. The third digit shall be a decimal number unless CIDs 000 through 999 are in use. Overflow from the first 1,000 codes shall be accomplished by insertion of a letter in the last digit. The letters "A" through "E" shall be used for overflow. No overflow codes shall be assigned when three- digit decimal codes are available. The maximum number of codes shall be 1,500. When the CIDS parameter is in the off state, DARC shall reject the message.

d. Aircraft Identification (AID).- It shall be possible to identify an aircraft by name with up to seven alphanumeric characters. The first character shall always be a letter. The remaining six characters may be either numbers or letters. No special characters shall be allowed. In the event that the AID is not unique within the sector's flight list or track file (or system flight list or track file in the case of "/OK" messages), DARC shall reject the message.

The DARC system shall recognize and reject R-console and GPO inputs which attempt to assign an AID to a discrete beacon code currently being associated with an AID. These associations are contained in both the master flight list, which is defined as all associations entered for automatic track initiation from all PVDs in DARC, and the track file, which contains associations on all aircraft currently tracked in DARC. When this occurs, the illegal entry indicator on the R-console keyboard shall be illuminated and a descriptive error message shall be displayed in the preview area of the associated PVD.

3.2.2.11.2.1 Track Initiation.- DARC shall perform two types of track initiation: (1) operator-selected or computer-assigned discrete beacon code target, automatic initiation; and (2) trackball-designated, manual initiation. When a track initiation message is input by the controller, if the target is not in the initiating sector's airspace an ineligible response shall be displayed in the preview area. A logic override "/OK" action shall be available to the controller to use in conjunction with the track manual initiation message. However, the override shall not allow track initiation on any target already tracked by another sector. The methods and messages for each type of track initiation shall be as described in the following two paragraphs.

3.2.2.11.2.1.1 **Automatic** Track **Initiation.-** The code request (QB type) message shall be used to assign a code to a flight and to enter the flight in the flight list. A discrete beacon code shall not be assigned to more than one aircraft. The flight data table (FDT) and flight list for the associated PVD shall be updated with the entered data and, when the conditions in par. 3.2.2.9.2 are satisfied, the track shall be automatically initiated.

3.2.2.11.2.1.2 Manual Track Initiation.- The track (QT type) message shall be used to initiate a track for a flight. The track shall be initiated at the point represented by the trackball coordinates. The entering sector shall be assigned control of the track.

3.2.2.11.2.2 **Enter** Assigned **Altitude.-** The assigned altitude (QZ type) message shall be used to change the assigned altitude for the specified track or flight list entry. DARC shall display the assigned altitude in either the associated full data block, or the flight or hold list, as appropriate.

3.2.2.11.2.3 Cancel **Track.-** The drop track only and remove strip messages (QX type) shall be used to discontinue the processing of a particular track. The remove strip message shall also be used to remove any track, flight list, and hold list data relating to the flight from the DARC system.

3.2.2.11.2.4 Reported **Altitude.-** The reported altitude (QR type) message shall be used by DARC to set the established altitude equal to the controller-entered reported altitude. The reported altitude field in the aircraft's data block shall be updated to reflect the entered altitude data.

3.2.2.11.2.5 **Hold/Release.-** The hold (QH type) message shall be used to initiate, terminate, or cancel a hold action for a specified flight. The hold fix shall be the current track position. A maximum of 50 entries shall be permitted in a PVD's hold list.

3.2.2.11.2.6 **Modify** Altitude Filter **Limits.-** The modify altitude limits (QD type) message shall be used to enter the sector's low and high altitude limits. These altitude limits shall be used for mode C limited data block filtering.

3.2.2.11.2.7 **Request/Suppress** Data **Block.-** The request/suppress data block (QP type) message shall be used to request, delete, or temporarily suppress the display of the data block for an individual aircraft at the entering sector.

3.2.2.11.2.8 Update Beacon **Code List.-** The code delete/insert (QB type) message shall be used to specify beacon codes (mode 3/A) that shall be deleted from or added to the beacon code list for the PVD associated with the message. These codes shall be used for display

3.2.2.11.2.1.1 **Automatic** Track **Initiation.-** The code request (QB type) message shall be used to assign a code to a flight and to enter the flight in the flight list. A discrete beacon code shall not be assigned to more than one aircraft. The flight data table (FDT) and flight list for the associated PVD shall be updated with the entered data and, when the conditions in par. 3.2.2.9.2 are satisfied, the track shall be automatically initiated.

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3.2.2.11.2.2 **Enter** Assigned **Altitude.-** The assigned altitude (QZ type) message shall be used to change the assigned altitude for the specified track or flight list entry. DARC shall display the assigned altitude in either the associated full data block, or the flight or hold list, as appropriate.

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3.2.2.11.2.8 Update Beacon **Code List.-** The code delete/insert (QB type) message shall be used to specify beacon codes (mode 3/A) that shall be deleted from or added to the beacon code list for the PVD associated with the message. These codes shall be used for display

3.2.2.11.2.18 Read Altimeter Data.- The altimeter request (QD type) message shall be used to request the display or printout of stored altimeter setting data for specified altimeter reporting stations.

3.2.2.11.2.19 Interim Altitude.- The interim altitude (QQ) message shall be used to change or delete the interim altitude of the specified track or hold list entry. DARC shall display the interim altitude in the associated FDB or hold list entry, as appropriate.

3.2.2.11.3 Field Select Controls.- This group of switches permits the controller to select which, if any, track data are to be displayed in the FDBs. The following functions shall be provided:

Category	Result
AIR IDENT	Display the flight identification field.
ASG ALT	Display the interim altitude field (when available); or, if the interim altitude is not available, display the assigned altitude (when available).
REP ALT	Display the reported mode C altitude (when available) in hundreds of feet; or, if mode C altitude is not available, display the established altitude (when available) in hundreds of feet.
ESTAB BCN CODE	Display appropriate field E data.
LEADER	Display the FDB leader.
POS SYMBOL	Display the track position symbol.
CID	Display the appropriate field D data.

3.2.2.11.4 Category Key.- DARC shall use category key #2 to select the radar sort boxes. The RSB selected by the current position of the trackball consisting of the RSB number, the three-letter mnemonics of the four associated radars with preferred and supplementary indicators, barometric pressure reporting point number, and altitude stratification flag shall be displayed.

3.2.2.11.5 Rotary Switches.- The following rotary switches shall be implemented:

a. **History.-** Radar target histories (zero to a maximum of five).

b. **Vector Length.-** Display a velocity vector on all FDBs indicating the predicted distance and direction the aircraft shall fly in the specified number of minutes (0, 1, 2, 4, or 8).

c. **Range.-** A 14-position rotary switch shall allow the controller to select the range (display radius) of a PVD. See par. 3.2.2.2.7 for a list of the 14 range settings and the corresponding actual ranges expressed in nautical miles.

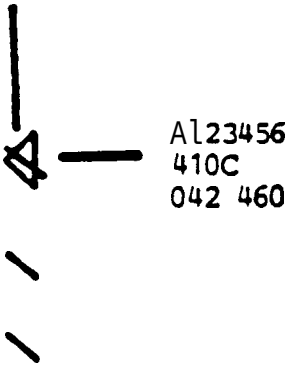
d. **Leader Length.-** A four-position rotary switch shall allow the controller to select the leader length between the tracker predicted position symbol and the FDB character array. The following are the four selectable values expressed in inches:

0.0
0.625 $\pm$ .0625
1.25 $\pm$ .0625
2.50 $\pm$ .0625

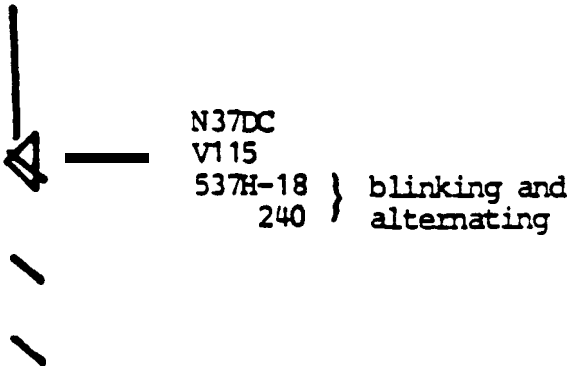
3.2.2.11.6 Trackball.- The trackball cursor shall be updated per the incremental position data obtained from the R-console data messages.

3.2.2.12 Display Formats.- DARC shall provide the display formats as prescribed in the following paragraphs.

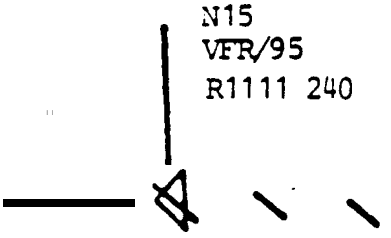
3.2.2.12.1 Full Data Blocks.- DARC shall process and display full data blocks (FDBs) composed of a position symbol, up to three lines of alphanumeric data, a leader, and a velocity vector. The basic alphanumeric portion of the FDBs shall consist of seven fields. Each field shall be switch selectable (hardware). Field A shall consist of seven character positions that comprise the aircraft identification. Field B shall consist of four characters that contain interim or assigned altitude information. Field C shall consist of four characters that provide established altitude information. Field D shall contain either three characters that comprise the computer identification number or a four-digit assigned code of the track, depending on the state of the nonadaptable parameter (CIDS). Field E shall use four characters to display a variety of data based on a predetermined set of precedence rules. If the FDB is associated with a remote track, an "R" shall be displayed in the first character position of field D. In this case, the data in fields D and E shall be extended one character position to the right. The position symbol shall be located at the correlated track position. Both manual and automatic selection of leader length shall be possible. The velocity vector assigned to each data block shall be expressed in nautical miles per minute. Figure 3-3 provides examples of full data blocks.



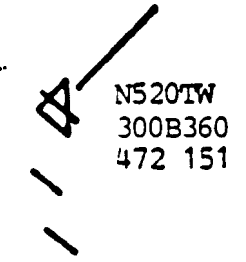
a. Mode C reported altitude 41,000 ft. is in conformance with assigned altitude.
b. CD is 042.
c. Groundspeed = 460 knots.
d. Leader length = 1/2 in. (switch position 1)



a. V115 indicates that the A/C has a mode C reported or operator entered altitude of 11,500 ft., but no assigned altitude.
b. CD is 537.
c. Field E blinks with the handoff indicator H-18 where 18 is the receiving sector number and alternates with the groundspeed (240 knots).

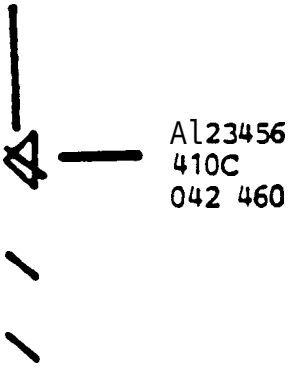


a. Assigned altitude is "VFR". Mode C reported altitude (lead-&J "0 " suppressed) is 9,500 ft.
b. Beacon code is 1111.
c. Groundspeed = 240 knots.
d. "R" denotes a remote data block track.



a. Assigned blocked altitude of 30,000 to 36,000 feet is within tie mode C reported altitude.
b. CD is 472.
c. Groundspeed = 151 knots.

Figure 3-3. Full Data Block Examples (Sheet 1 of 3)



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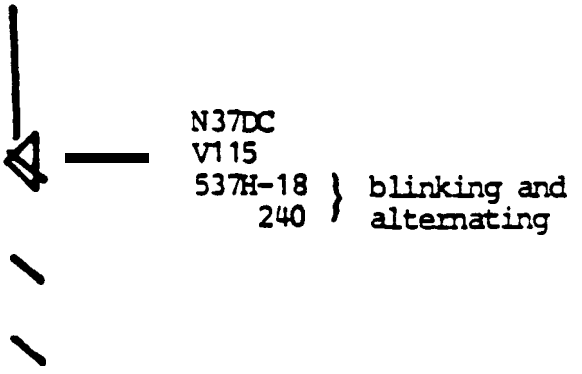

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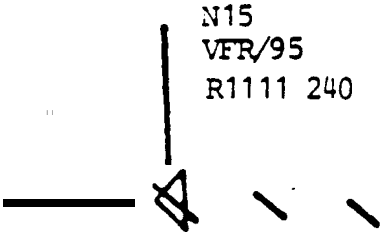

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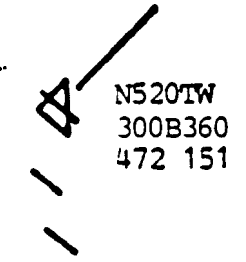
d. "R" denotes a remote data block track.



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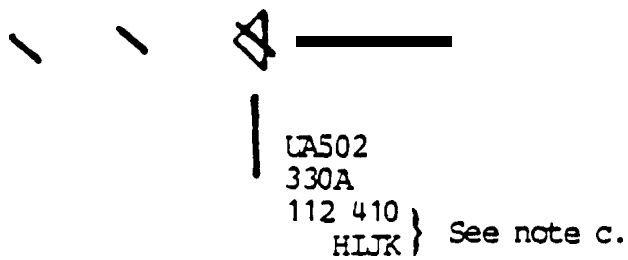
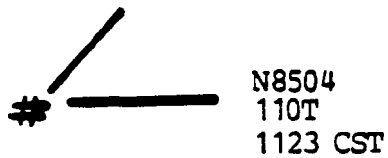
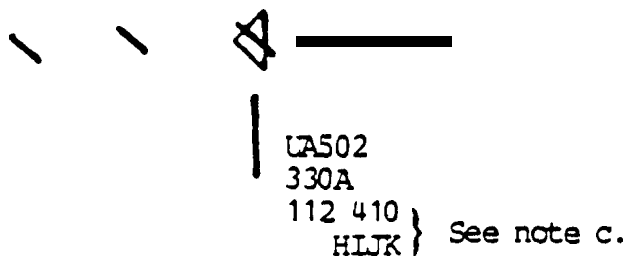


a. A/C assigned altitude is in conformance with entered reported altitude of 33,000 ft.
b. CD is 112.
c. A/C report "HLJK" blinks and alternates with nonblinking groundspeed (410 knots).



a. Interim altitude is 11,000 ft.
b. Assigned beacon code is 1123.
c. Coast status indicator "CST" blinks after an adaptable period.

Figure 3-3. Full Data Block Examples (Sheet 3 of 3)



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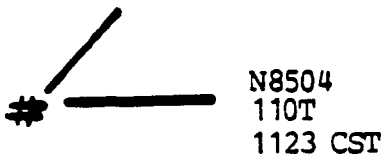

a. Interim altitude is 11,000 ft.
b. Assigned beacon code is 1123.
c. Coast status indicator "CST" blinks after an adaptable period.

Figure 3-3. Full Data Block Examples (Sheet 3 of 3)

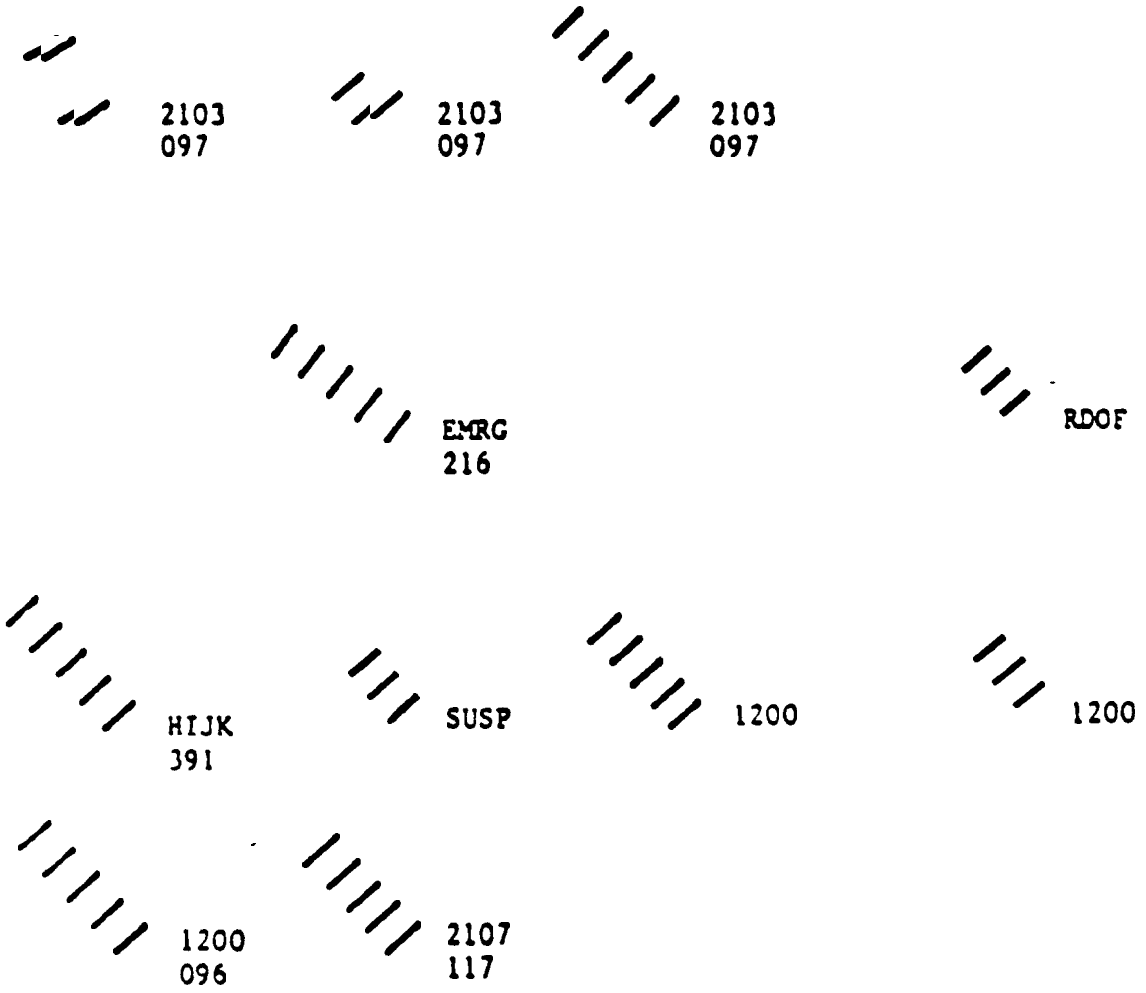

Figure 3-4. Limited Data Block Examples

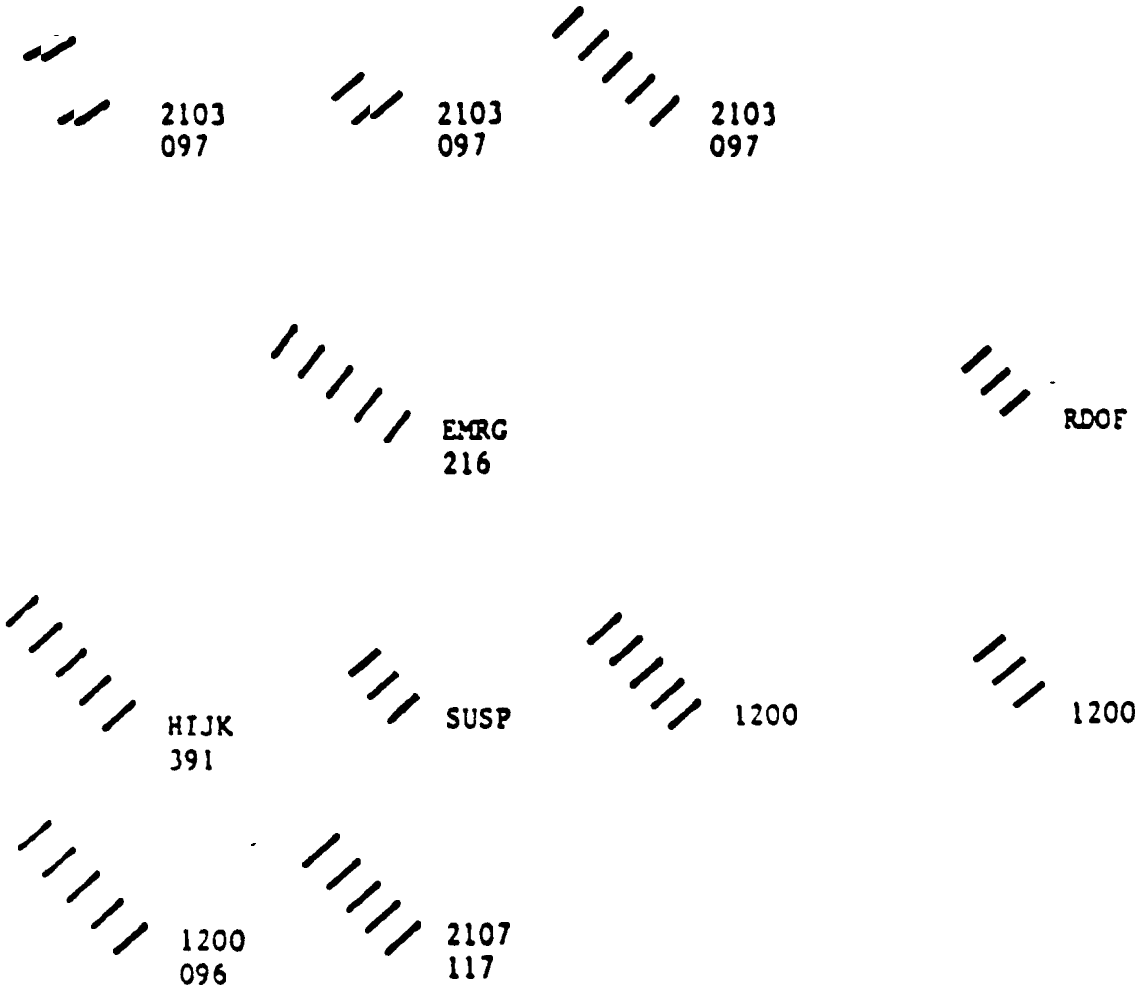

Figure 3-4. Limited Data Block Examples

displayed as two sets of line segments lying along a ray emanating from the radar site. The line segments shall indicate the directions of the initial and final strobe azimuth. Strobe message processing shall be enabled and disabled by a display filter key.

3.2.2.16 Status Message Processing.- This message shall be processed as part of the real time quality control function (par. 3.7.8.5a).

3.2.2.17 Error Message Processing.- In designing output error messages, particular attention shall be given to any DP-reported radar data errors. The CP shall buffer these error reports for an adaptable period of time. The CP shall scan the DP-reported error buffers to establish common error conditions reported from several different DPs. Common error conditions shall be summarized before printing. In addition, all error messages shall have an adaptable number of occurrences within an adaptable time period before a summarized message is printed, indicating the number of error occurrences summarized. These error message output control functions shall have no effect on parameters controlling automatic reconfiguration.

3.2.3 Transition Between Prime Channel and DARC

Each PVD employed with DARC shall include a channel selection switch. This switch shall control logic within its DGU and cause either the prime channel or DARC to be selected as the source of display data for the PVD (reference appendix A). Data from the DARC system shall be displayed on the PVD within 1.0 second after activation of the PVD switch to the DARC-driven position.

3.2.4 Initial System Startup

When the DARC operational disk is in the ready state (disk up to speed) and the load switch for the online CP has been activated, the online CP shall download the operational programs (including mosaic and rho/theta filter, but excluding geographic maps) into the CP, DPs, and QPs within 85.0 seconds. The system, including a unique, nominal size (135 lines, 65 symbols) geographic map per PVD, shall be available for use within 120 seconds for a system consisting of 1 active CP, 1 spare CP, 12 active DPs, 1 spare DP, and 1 QP.

3.2.5 Recovery From Failures

3.2.5.1 Recovery From Alternating **Current** Power Failure of **2.5** Seconds or **Less.-** For a power interruption of 2.5 seconds or less, all data in the CP, QP, and DP memories shall be retained. Within 1.0 second of alternating current (ac) power restoration, following a systemwide power interruption, the prior display images shall be reestablished: normal processing shall resume within the DPs and processing shall resume within the CP. Within 45.0 seconds of ac power

restoration, disk accesses shall be allowed and normal processing shall be resumed systemwide. Following a minimum of six power failures, of any duration, within an elapsed 24-hour interval, the system shall recover by means of an initial startup (par. 3.2.4).

3.2.5.2 Recovery From AC Power Failures Greater Than **2.5** Seconds.- Recovery from ac power failures greater than 2.5 seconds shall be performed by an initial startup (par. 3.2.4).

3.2.5.3 Recovery **From CP Failure.-** From the time an automatic or manual swi tchover to a CP has occurred, within 30.0 seconds that CP shall be online, shall have a complete track file and flight list, and shall support all DP functions.

3.2.5.4 Recovery **From DP Failure.-** From the time an automatic or manual swi tchover to the spare DP has occurred, within 60.0 seconds that DP shall present normal displays on its associated PVDs, including a single geographic map for each PVD. Weather, target, and track data shall build up as the radar scans continue.

3.2.6 Automatic Reconfiguration

The DARC system shall include an automatic reconfiguration capability. Three sets of criteria shall be employed in DARC to effect automatic reconfiguration. The first set shall be error status data sensed at the interface of critical hardware devices. The second shall be software self-checks. The results of these two sets are reported in the normal status summary reporting sequence. The third set shall be classified as the inability to receive status from, or to communicate with, a device. The DARC control processor software shall contain fault analysis software to perform error analysis of the status data within the CP and to determine when a hardware configuration change should be implemented. The fault analysis software shall be designed to analyze significant error status indications. For example, the receipt of a single instance of certain specified errors or the recognition of an inability to communicate with a device may be sufficient indication to initiate a configuration change. Other error status conditions shall be examined over time and compared to tolerance thresholds before a decision for a configuration change shall be initiated. Each threshold shall be within a system parameter period of time. From the hardware point of view, a control processor monitor (CPM) shall be installed in the system status and control cabinet which shall initiate an automatic configuration change of CPs whenever certain status conditions exist. The CPM shall contain a watchdog timer which shall be periodically reset by the software as an indication of successful operation. Failure to reset the watchdog timer within the prescribed time limit shall serve as a failure indication. When the watchdog timer runs out, an automa tic changeover to the standby CP shall be initiated.

3.2.6.1 Automatic Configuration Changes.- Automatic configuration changes are required for the RMUX A and B buses, display processors, control processors, QP, disk drives, disk controllers, tape drives, line printer, and input/output typewriters. Automatic reconfiguration of DGUs and DCVGs shall also be required to support the functions specified in appendix A. All configuration changes shall be accomplished within 30.0 seconds. This time shall begin immediately following failure detection and shall consist of: the time for switching of the failed unit; rebuild of dynamic data, when necessary; a successful performance of confidence tests to verify proper operation; and start of presentation of data on the displays. This requirement shall apply to single failures only, and where mosaic or single geographic maps per PVD are required, a maximum of 15 additional seconds each shall be allowed. Where multiple units of the same type fail, analysis and reconfiguration shall be accomplished in series on a first-detected, first-served basis. The response time requirements stated for single unit failures shall apply to each of the multiple reconfigurations. Where display processors are reconfigured, the displays being serviced by that DP may go blank and radar data shall be allowed to build up with the normal radar scan. All other reconfigurations shall be accomplished without display screen blanking. In no case shall more than two display refresh cycles (approximately 37 milliseconds) of data be lost due to input data selector (IDS) or refresh output controller (ROC) reset. Radar data lost during RMUX reconfigurations, IDS resets, or ROC resets shall not be available for display. The reconfiguration task shall have a high priority in CP software. The general approach to be employed to reconfigure the three basic hardware elements is specified in pars. 3.2.6.2 through 3.2.6.4.

3.2.6.1.1 Redundant Units.- Redundant units contained in DARC for meeting reliability requirements, as specified in par. 3.7.1, shall be switched over into the operational DARC system without manual intervention. In the event that an error condition is isolated to a single CP hardware peripheral device such as the disk/disk controller, new requested tasks shall be inhibited and existing scheduled tasks shall be completed, allowing a graceful reconfiguration to the standby CP. A unit failure of this type shall not cause loss of data except for data unique to the failed peripheral and data of a transitory nature that may be rapidly reestablished by controller input or otherwise; e.g., forced data block coordinate position. A CP processor failure or any CP unit failure which cannot be isolated shall be defined as a CP failure. The online CPs shall keep a master flight list using CID numbers consisting of PVD flight lists from each DP and a record of track files contained in all DPs. These data shall be current within 12.0 seconds. When a DP fails, the online CP shall load the flight lists and track files as appropriate into the replacement DP for the following purposes:

a. Reestablishing the flight list in order to enable automatic track initiation to proceed.

b. Enabling automatic restart of previously tracked aircraft. The track restart procedure shall be similar to the initiate track action described in par. 3.2.2.9.2 and shall employ last-calculated velocity, last-predicted position (both as reported by the prior DP), and code where available. The probability of successfully restarting a track is recognized to be a direct function of time lapse since last position and velocity update, interim track maneuvers, local track density, and track type (discrete, nondiscrete, or primary). Accordingly, test conditions taking this dependency into consideration shall be established to demonstrate this function.

In the event of online CP failure, the offline CP shall be configured online and resume processing. However, messages in transit at the moment of failure are subject to loss in the event that the failed CP is a party to the messages. Additionally, remote data blocks are subject to loss. In the event that a DP is scheduled to be replaced with a spare DP, the configuration data, display parameters, and map shall be downloaded from the CP to the spare DP and the spare DP shall be configured online. The replaced DP shall be set to unavailable.

3.2.6.2 RMUX Reconfiguration.- A DP shall be configured at startup time to either RMUX A or B for the receipt of incoming radar data. Whenever a DP reports certain error indications to the CP, the CP shall conduct a fault analysis to determine when a switch to the other bus is required. The analysis shall be conducted on a systemwide basis and shall employ radar/bus error count and status data as provided by the QP and the DPs. Three situations can exist: the RMUX bus may be malfunctioning, the received radar data may contain errors, or a DP may be malfunctioning. The following test message errors shall be detected by the QP and the DPs and shall subsequently be analyzed to determine whether the radar or the RMUX bus is the source of the errors.

a. Missing beacon test target error.

b. Missing search test target error.

c. Test target scan time error.

d. Test target range error.

e. Test target mode 3/A error.

f. Test target mode C error.

g. Test target run length error.

h. Test target azimuth error.

b. Enabling automatic restart of previously tracked aircraft. The track restart procedure shall be similar to the initiate track action described in par. 3.2.2.9.2 and shall employ last-calculated velocity, last-predicted position (both as reported by the prior DP), and code where available. The probability of successfully restarting a track is recognized to be a direct function of time lapse since last position and velocity update, interim track maneuvers, local track density, and track type (discrete, nondiscrete, or primary). Accordingly, test conditions taking this dependency into consideration shall be established to demonstrate this function.

In the event of online CP failure, the offline CP shall be configured online and resume processing. However, messages in transit at the moment of failure are subject to loss in the event that the failed CP is a party to the messages. Additionally, remote data blocks are subject to loss. In the event that a DP is scheduled to be replaced with a spare DP, the configuration data, display parameters, and map shall be downloaded from the CP to the spare DP and the spare DP shall be configured online. The replaced DP shall be set to unavailable.

3.2.6.2 RMUX Reconfiguration.- A DP shall be configured at startup time to either RMUX A or B for the receipt of incoming radar data. Whenever a DP reports certain error indications to the CP, the CP shall conduct a fault analysis to determine when a switch to the other bus is required. The analysis shall be conducted on a systemwide basis and shall employ radar/bus error count and status data as provided by the QP and the DPs. Three situations can exist: the RMUX bus may be malfunctioning, the received radar data may contain errors, or a DP may be malfunctioning. The following test message errors shall be detected by the QP and the DPs and shall subsequently be analyzed to determine whether the radar or the RMUX bus is the source of the errors.

a. Missing beacon test target error.

b. Missing search test target error.

c. Test target scan time error.

d. Test target range error.

e. Test target mode 3/A error.

f. Test target mode C error.

g. Test target run length error.

h. Test target azimuth error.

radar. When two or more DPs are producing the same error, the radar or RMUX is at fault and the condition shall be output to an IOT. The results of an error condition determined to be associated with only one DP shall be a commanded configuration change to a spare DP (when available).

3.2.6.4 Control Processor Reconfiguration.- The redundant CP shall serve, while in standby status, as a backup unit for ready use in the event of online CP failure. This shall be accomplished by means of maintaining current status information within the standby CP concerning the operability and availability of all DARC units as well as associated external units such as radars. Additionally, the standby CP shall maintain, or have ready access upon switchover to online status, to pertinent data base information including, in particular, active and inactive flight data; display range, center, and filtering data; and mosaic map application data. However, there is no requirement for the online CP to maintain within the standby CP the status error counts for unit reconfiguration and error message printing. The online CP shall downgrade the availability of the standby CP to unavailable whenever the standby ceases to communicate or reports critical status errors. The CPM watchdog timers shall be independently reset by both CPs. When the standby CP fails to reset this timer, the CP shall be set to unavailable. A message printed at the IOT shall notify the Systems Engineer of the status change or failure condition. Visual and audible alarms will also be generated. When the online CP fails to reset the watchdog timer and there is a standby CP, the CPM shall effect an automatic switchover. Whenever the online CP experiences self-check failures or failure to maintain communication with its full quota (system parameter) of DPs, it shall not reset the watchdog timer, thus causing an automatic switchover to the standby CP. CP reconfiguration sequences and timing restrictions shall be as specified in figure 3-5.

3.2.6.5 Peripheral Device Reconfiguration.- The CP fault analysis software shall perform when fault conditions are detected in the disk drive, disk controller, input/output typewriters, line printer, or tape drive. Errors from the disk drive or disk controller shall be counted and compared to a threshold value. When the threshold value is exceeded the CP shall halt and allow the watchdog timer to configure to the other CP and disk subsystem as specified in par. 3.2.6.1.1. Detection of a line printer or IOT failure shall cause an online IOT to assume the functions of the failed unit.

On detection of a tape drive error, the failed drive shall be configured offline, and the redundant tape drive, if in standby state, shall be configured online. When no tape drives are available, the CP shall disable system analysis recording and cause printout of the error message TAPE DRIVE SYSTEM FAILURE.

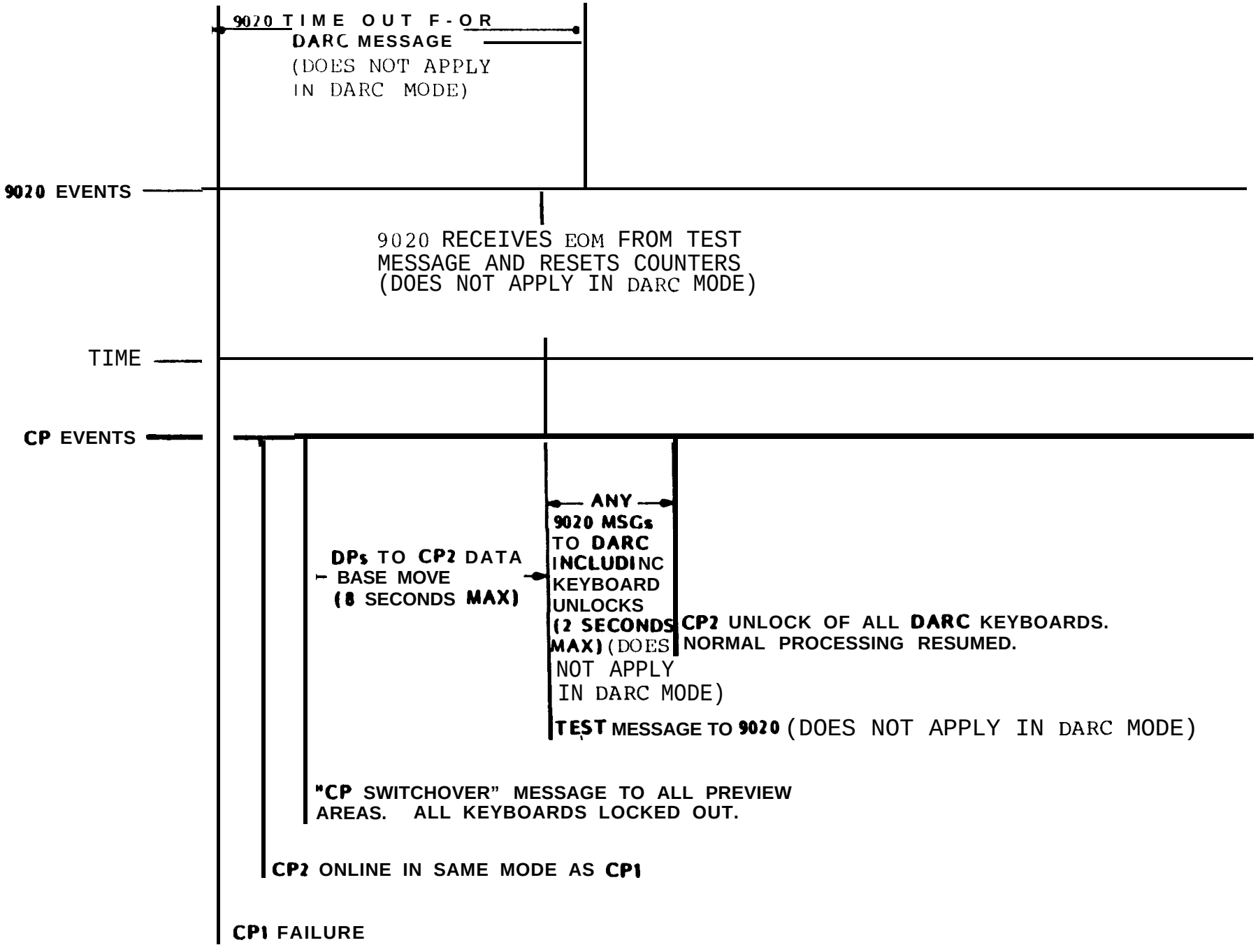

Figure 3-5. CP Reconfiguration Sequences and Timing Restrictions

3.2.6.6 DARC/CCC and WMSU Processor Interface Configuration.- Errors from the GPO, GPI, and WMSU interface adapters shall be monitored and reported on appropriate input/output (I/O) devices. Details of this interface are specified in the appropriate ICD (see par. 2.3).

3.2.6.7 Additional Reconfiguration Requirements.- Upon each initialization and each reconfiguration of the DARC system, and upon request via the IOT, the unit configuration report shall be printed on an IOT or the line printer. The report shall be queued for printout within 20.0 seconds of issuance of a reconfiguration command. Should no spare be available for any required reconfiguration cited above, a message shall be printed stating that no spare is available.

3.2.7 System Analysis Recording

The DARC system shall extract and record data entered at the R-console, data sent to the preview area, and central flight file data. The central flight file data shall include initial conditions, flight file entries/deletions and causes, and flight file modifications and causes. These data shall be used in post-air-traffic incident analysis. The recording function shall be controlled via the IOT. The data shall be recorded on nine-track tape recorders which shall be interfaced via controllers to CP1 and CP2. The data recording format shall be compatible with the primary control program (PCP) version of IBM's 360 operating system (OS).

3.2.8 Utilization

The DARC system shall calculate and print out the percent of idle and busy times for specified processors and communications channels within DARC. The channel utilization command (CU) shall be used to control the collection and output of channel utilization results. The collected information shall be analyzed and printed in a channel utilization report (UTIL). RCC channel analysis shall count poll data, excluding fetch data, and compute the count as a percentage of the full load R-console data rate. Activation of this function and the time period of analysis shall be controllable via the IOT. The printout shall be in English text and shall include the processor or channel name; the analysis idle, busy, start, and stop times; and the percent of utilization. It shall be possible to analyze up to two processors and five channels simultaneously.

3.3 DARC INPUT MESSAGE LOAD, TRACKING LOAD, AND PROCESSING TIME

Data are received at the DARC RMUX from each DRG installed at an ARTCC. Messages are delivered by each of three DRG channels operating at a 2,400 bps rate. Synchronizing fields used between messages on the incoming transmission lines are removed by the DRG which raises start-of-message and end-of-message lines for each of its three channels.

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3.6 DARC SYSTEM EQUIPMENT

The DARC data processing equipment necessary to perform the functions defined herein shall include all computing equipment, memory equipment, input/output interface control equipment, peripheral equipment, and peripheral equipment adapters. Supplementary processing boards (SPBs) shall be utilized to preprocess radar data and CP data for the DP and shall include a minimum of 64K 16-bit words of memory suitable for the storage of application software. Such special design DARC upgrade input/output interface control equipment shall meet the requirements of FAA-G-2100/1, 3, 4, and 5. In the event that random access memory (RAM) MOS memory is employed for the purpose of storing application software at one or more locations within the DARC system, a provision for battery backup shall be included for each location. The battery backup shall be effective for at least 2.5 seconds (see par. 3.2.5.1).

3.7 RELIABILITY AND MAINTAINABILITY REQUIREMENTS

Reliability and maintainability requirements specified for DARC shall apply to all equipment and interconnecting cables comprising DARC, including peripheral equipment.

3.7.1 DARC System Reliability

The original DARC system was designed to handle 60 PVDs with 15 radars supplying input data. The enhanced DARC system is designed to process 72 PVDs with 24 radars supplying input data. Both DARC systems, including all peripheral equipment, shall provide a mean-time-between failure (MTBF) (as defined in MIL-STD-781) of at least 1,250 hours.

3.7.2 DARC System Maintainability

The mean-time-to-repair (MTTR) for any size DARC system, excluding the tape drives, shall be 0.50 hour or less. MTTR shall include the period of time measured from the time an electronic technician with the necessary tools and spare parts begins the diagnostic procedures on the failed DARC system until the time when the failed equipment is operating as per the specification. Repair, as used herein, refers to restoration of the DARC system to full system capability and does not include actual time to repair the replaced unit. Time-to-repair the DARC system shall be less than 1 hour for 95 percent of system failures. Demonstration of all time-to-repair specification requirements shall be included in the maintainability tests performed as specified in par. 4.3.2.2 and MIL-STD-471.

3.7.3 DARC System Failure

For purposes of reliability prediction and testing, the DARC system shall be considered failed if any of the following conditions apply:

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3.7.3 DARC System Failure

For purposes of reliability prediction and testing, the DARC system shall be considered failed if any of the following conditions apply:

Each mechanical component used in the units shall be designed to minimize preventive maintenance and shall have a service life of at least 20,000 hours.

3.7.6 Hardware Failure Sensing and Status Registers

Parity generation and checking shall be provided on all data transfers to and from all external interfaces and peripheral equipment. Failure sensing and status registers shall be supplied with the DARC system to meet the reliability, maintainability, and other requirements of the specification.

3.7.7 Reliability Design Verification Techniques

The following tasks as a minimum are required to assure compliance with the requirements specified herein.

3.7.7.1 Reliability Program Plan.- A plan to implement a reliability program in accordance with MIL-STD-785 shall be prepared. The reliability program, and its management, shall be a clearly identifiable organizational element responsible for the effective execution of all reliability requirements and efforts related thereto. This plan shall be implemented and the results of the reliability program shall be documented in the reliability and maintainability report.

3.7.7.2 Program Tasks.- The reliability program shall include the following as a minimum:

a. Reliability **Modeling.-** DARC shall be reliability modeled. The model shall be of sufficient detail to identify critical paths or items whose failure shall cause system failure or degraded operation. The model shall be representative of the system's operational capability, and all states, including the degraded mode, shall be clearly delineated. Graphical and mathematical techniques shall be used to validate model accuracy. Tools, program description manuals (PDMs), user's information on keeping models current, and use of the model shall be provided. The modeling software shall be executable on equipment available at the FAA Technical Center. Modeling tools, program description manuals detailing user's information on keeping models current, and use of the models are required. Modeling software developed for this purpose shall be provided and must execute on FAA equipment.

b. **Reliability** Analysis.- Reliability analyses and predictions, including failure modes, effect, and analysis, shall be performed both during the preliminary design phase and as a demonstration of conformance to requirements prior to the final design freeze. These analyses shall be detailed assessments of the design and shall be conducted to a level

sufficient to provide assurance that specified reliability criteria shall be met. The methods of MIL-STD-756 shall be applied, using definitions of MIL-STD-721 and failure rate data from MIL-HDBK-217, if available. If failure rate data is not available from MIL-HDBK-217, manufacturer-supplied data shall be used.

c. **Reliability** Testing and **Demonstration.-** A reliability demonstration test plan in accordance with MIL-STD-781 shall be prepared as a part of the qualification and acceptance test plan. The plan shall include scheduling, types, and objectives of tests during the program. An overall DARC system reliability demonstration test shall be performed as specified in par. 4.3.2.1. Criteria for successful demonstration of specified reliability shall be defined.

d. **Failure** Reporting, Analysis, and Corrective Action.- A closed-loop system of failure reporting for both factory and onsite failures shall be established. As a minimum, failures occurring from the time the design is frozen until the installed DARC system has been accepted shall be reported. Each failure shall be analyzed to ascertain its cause. Failure data reports to the component levels, including individual and trend analysis results, shall be maintained in a central file to which the Government shall have unlimited access.

3.7.8 DARC Maintenance

Ease and speed of repairs to DARC are required so that maximum readiness of the DARC equipment is obtained. Immediate indication of the need for maintenance is essential in order to effect repairs in a timely manner. Preventive maintenance on DARC shall normally be performed during times when DARC is not supplying radar data to the DGUs. Exceptions to the foregoing may occur. At such times the DARC element requiring preventive maintenance may be serviced provided that there is no interruption to the correct presentation of processed air traffic control information to the displays. The maximum effort allowed for corrective and preventive maintenance on the DARC system, excluding the tape drives, shall not exceed 2.0 employee-hours per day. This time shall not include bench repair time. The software and hardware maintenance features as stated herein shall provide the means to meet the maintainability requirements as set forth in this specification. The maintainability program shall be in accordance with MIL-STD-470, including, but not limited to the following:

a. Cost tradeoffs and reliability considerations involved in the application of both preventive and corrective maintenance.

b. Number and skill level of maintenance personnel required to maintain the system.

c. Level of diagnostic support.

d. Printed circuit board (PCB) problem analysis and repair techniques in the field.

e. Special task and test equipment for bench repair items.

f. Repair verification techniques.

3.7.8.1 Maintenance Approach.- The maintenance approach shall be to localize the failures through use of software and hardware maintenance features and to replace the failed module, element, or pluggable unit from spares. The actual repair of the replaced item shall be accomplished in a designated bench repair area. The mean bench repair effort for any assembly, subassembly, module, or PCB, excluding the tape drives, shall not exceed 4.0 employee-hours and the maximum bench repair effort shall not exceed 8.0 employee-hours. Diagnostic software and maintenance features shall be designed to rapidly isolate malfunctions to the replaceable module level excluding only the display generator (DG) I/O PCBs. Where PCBs are used, the replaceable module shall be considered to be the PCB level, unless boards with only plug-in integrated circuits (ICs) are used. In this event, the replaceable module level shall be considered to be not more than 10 ICs on a board. A means of localizing failures to the component level during bench repair of the failed module shall be provided. Boards with only plug-in integrated circuits shall not be replaceable or removable for repair. Such boards must be repaired in place. Particular attention shall be paid to the DARC input interface with the DRGs and the DARC output interface with the DGUs. Diagnostic and test techniques shall be provided for these areas to isolate problems and test interface operation.

3.7.8.2 Software and Hardware Features.- The software shall consist of data processor diagnostic programs and those programs developed for system integration that are capable of being used as system diagnostics. Hardware shall present a software interface that allows application of computer program diagnostic techniques. Hardware features shall include sensing and status registers, test points, and maintenance adjustments.

3.7.8.2.1 Test Points.- Test points (TPs) shall be provided for measurement and observation of such voltages and waveforms as are needed for installation, calibration, maintenance, and repair of individual units. Except where the functioning of circuits would be adversely affected by long leads, test points shall be accessible on the front panels or immediately behind the access doors of all units.

b. Number and skill level of maintenance personnel required to maintain the system.

c. Level of diagnostic support.

d. Printed circuit board (PCB) problem analysis and repair techniques in the field.

e. Special task and test equipment for bench repair items.

f. Repair verification techniques.

3.7.8.1 Maintenance Approach.- The maintenance approach shall be to localize the failures through use of software and hardware maintenance features and to replace the failed module, element, or pluggable unit from spares. The actual repair of the replaced item shall be accomplished in a designated bench repair area. The mean bench repair effort for any assembly, subassembly, module, or PCB, excluding the tape drives, shall not exceed 4.0 employee-hours and the maximum bench repair effort shall not exceed 8.0 employee-hours. Diagnostic software and maintenance features shall be designed to rapidly isolate malfunctions to the replaceable module level excluding only the display generator (DG) I/O PCBs. Where PCBs are used, the replaceable module shall be considered to be the PCB level, unless boards with only plug-in integrated circuits (ICs) are used. In this event, the replaceable module level shall be considered to be not more than 10 ICs on a board. A means of localizing failures to the component level during bench repair of the failed module shall be provided. Boards with only plug-in integrated circuits shall not be replaceable or removable for repair. Such boards must be repaired in place. Particular attention shall be paid to the DARC input interface with the DRGs and the DARC output interface with the DGUs. Diagnostic and test techniques shall be provided for these areas to isolate problems and test interface operation.

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the data path from the radar to the DARC input interface. In addition, DARC shall use the test messages as part of an internal self-check routine to verify proper operation of the DARC processor, whether or not any DGUs are configured to accept the data from DARC. Test messages shall not be displayed operationally on any PVD. However, the result of test message checks shall be displayed at an appropriate unit of the DARC equipment group. For FAA certification purposes, the DARC systems shall have provisions to display the test message data on any PVD by means of instructions entered from an IOT. The test message range and azimuth values for use by DARC shall be provided, as adaptation data pertaining to each radar site, and stored. When the received values in the test message deviate from the stored values predefined by a software parameter, an error message shall be printed. Message formats for the test message data are provided in the appropriate ICD (see par. 2.3).

3.7.8.4.1 **Test** Vector Error **Processing.-** DARC shall use the R-console fetch command to determine if a test vector (PVD) error occurred since the last fetch command. If the number of test vector errors reported during a specified fetch cycle interval exceeds the predetermined parameter TVED limit, DARC shall blank the PVD and display a PVD error message. DARC shall send notification of PVD errors to either the IOT or medium speed printer (MSP) for message print out.

3.7.8.5 Real Time Quality Control of Radar **(RTQC).-** The RTQC function shall be composed of a set of six independent tasks that perform detection and analysis of the digitized radar data supplied by the MRDP function. Each task shall accept and process only the data that corresponds to that task's assigned operation. The RTQC function tasks shall be performed for all radar sites assigned to the QP. Items 3.7.8.5a through f provide brief summaries of the six RTQC tasks.

a. **Status Message Monitoring.-** The status message monitoring task shall analyze the list of status messages received from a specific radar site. The analysis shall identify changes to specific fields in the status messages and shall determine if more or less than the nominal number of status messages are received. The detection of specified conditions shall cause the generation and printing of a report that describes the conditions.

b. **Test** Message **Monitoring.-** The test message monitoring task shall analyze the list of fixed beacon and fixed search test messages received from a specific radar site. The analysis shall determine the accuracy of the fields in the test message and whether the normal number of test messages are received. The detection of specified conditions shall cause the generation and printing of a report that describes the conditions.

c. **Radar Data Counts.-** The radar data counts task shall examine the radar data counts information provided by the MRDP function. The task shall detect excessive radar data and radar data error conditions. The detection of an excessive error or missing data condition shall cause the generation and printing of a report that describes the condition.

d. **Registration Analysis.-** The registration analysis task shall calculate registration errors for each radar site pairing specified through adaptation. A registration error shall be identified as a difference on range and azimuth between an assumed true target position on the stereographic plane and the reported target position in the stereographic plane. Registration correction factors computed by the registration analysis task for both range and azimuth shall be printed periodically and on request.

e. **Collimation Analysis.-** The collimation analysis task shall calculate the range and azimuth differences between beacon and primary data received from the same site. Collimation correction factors computed by the collimation analysis task for both range and azimuth shall be printed periodically and on request.

f. Permanent Echo Verification.- The permanent echo verification task shall calculate the mean range, mean azimuth angle, and standard deviation of the range and azimuth angle between the physical location of permanent echo search and beacon targets and the location of their associated radar returns. The results of the permanent echo verification analysis shall be printed periodically in accordance with the permanent echo number of scans parameter.

3.7.8.5.1 Design.- The RTQC program shall operate in either spare DP (optionally selectable via an IOT). At DARC startup, the RTQC program shall begin execution automatically in an adapted spare DP. When the DP selected for RTQC processing is needed for online display or maintenance purposes, the RTQC program shall be initialized and shall begin execution in the other spare DP. If both spare DPs are needed for other purposes, RTQC program execution shall cease. RTQC and DP programs shall be organized to minimize delay while exchanging one for the other. The highest priority shall be given to minimizing DP program delay. The online CP shall communicate with the DP providing RTQC so that the various RTQC printouts can be provided optionally at the IOT or line printer. Output routing shall be specified by the message group in adaptation (parameter ROUT). The messages shall be printed in uppercase characters with a maximum of 132 characters in each line. Each printed message shall be separated from adjacent messages by a single blank line. The IOT shall provide control for RTQC. DARC shall perform the RTQC function on a maximum of 24 radars. In the automatic mode, the RTQC function shall automati-

cally declare a radar site failure and initiate reconfiguration of radar sort boxes and rho/theta filtering. When a radar site is declared failed either by the automatic or IOT entry modes, the associated PVD system status control panel radar lamp shall be lit. The radar coverage control site status report shall record the results of a radar site failure. The RTQC program shall include the following functions.

a. Provision for automatic track initiation in order to enable autonomous operation of the RTQC tracker.

b. Filtering of track data, prior to use in RTQC analyses, in order to compensate for the lack of track enhancements/ guidance contributions normally provided by controller feedback.

c. Provision for automatic load alleviation in order to minimize any possibility of processor overload.

3.7.9 Independence of Subsystems

Design of the DARC system shall be such that a component failure in any one part of the system shall not induce a failure in any other part of the system. Failures in a redundant unit, if supplied, shall not affect the system operation. It shall be possible to service and turn power on and off on the offline redundant units, if supplied, without affecting the operation of the online units. Failures in any I/O channels and elements connected thereto shall not affect overall operation of DARC or the proper operation of elements connected to other I/O channels. Design of the DARC system shall be such that a component failure in any one part of the DARC system shall not induce a failure in any subsystem at the site. Each individual DARC equipment unit shall be capable of being disconnected or power cycled on and off without causing interaction with, or failure of, any other DARC unit or any other unit at the site.

3.7.10 Maintenance Aids

DARC shall be designed with sufficient maintenance panels, switches, test points, and indicators to allow detection, isolation, and repair of units to satisfy all requirements of this specification. The design shall employ the use of commercially available test equipment, tools, and fixtures for maintenance aids.

3.7.10.1 Special Tools and Special Test Equipment.- All special tools and special test equipment necessary for the installation, system and bench repair, adjustment, test, and maintenance of the new DARC upgrade hardware specified herein shall be required. The special tools and special test equipment shall include, but not be limited to, the following:

a. Alignment wrenches.

b. Jigs.

c. Special purpose test and circuit card extender cables.

d. Any PCB adapter connectors or test jigs necessary in the troubleshooting, maintenance, and repair of DARC PCBs.

In the event that firmware, (PROMs, etc.) is employed in the delivered DARC system, the necessary procedures, development programs, and assembly listings for the FAA Technical Center and the FAA Depot shall be required.

3.7.10.2 Standard Test Equipment.- An itemized list of standard commercially available test equipment, required for maintenance of DARC, shall be provided in accordance with FAA-G-1210. This list shall indicate the make and model and describe the main and functional characteristics of each item.

3.8 INSTALLATION AND CHECKOUT

Installation and checkout shall proceed in accordance with approved site installation documents. While installation and checkout are performed in an ARTCC, adjustment of the installation team working hours may be required to prevent conflicts with air traffic control operations.

3.8.1 Installation Materials

All power wiring materials supplied or specified shall be in accordance with the National Electrical Code, NEPA No. 70.

3.8.2 Installation Interconnecting Cables

There is a requirement for DARC interconnecting cables for the particular equipment configuration to be installed at each designated facility.

3.9 COMPUTER PROGRAMS

All programs shall be in the form of object disks with appropriate listings. The disk maintenance and diagnostic program shall be in the form of a source tape. In addition to all of the above, two copies of each source tape shall be provided for all deliverable programs, as well as completed program documentation (PDM, user's manual, computer program functional specification).

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b. Jigs.

c. Special purpose test and circuit card extender cables.

d. Any PCB adapter connectors or test jigs necessary in the troubleshooting, maintenance, and repair of DARC PCBs.

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decimal-to-hexadecimal (if used) conversion, acceptance of alphabetical data, storage allocation, input/output, and translation and control.

3.9.2.1.2 Additional Programs Necessary for Program Compilation.- All programs necessary to maintain (e.g., update or change adaptation parameters) the operational and maintenance programs at a central Government facility are required. Programs which allow compilation of symbolic source programs and initialization data into the exact format required to be stored on the peripheral data storage media prior to loading into the DARC processing equipment are required. A map assembler shall be provided which shall accept map lines and symbols, with associated class/types, and store them on peripheral storage organized according to the four map display filter keys. Each class/type shall be assigned to a particular map key at map assembly time. Three forms of inputs shall be accepted by the assembler:

a. Latitude and longitude in alphanumeric form. The map assembler shall convert the latitude and longitude to system coordinates.

b. System X, Y coordinates in alphanumeric form.

c. System X, Y coordinates in ACES object text tape form.

3.9.2.1.3 Loaders.- Loader programs for loading operational, support, and test programs are required. These programs shall load object programs produced by the assembler, or data from the peripheral data storage media or card reader, into primary and peripheral data storage. The loader programs shall be self loading. Non-operational object programs shall be callable from a library under program control.

3.9.2.1.4 Dumps.- Dump programs to transfer the contents of any portion of storage to the peripheral data storage, the line printer, or to the input/output typewriter shall be incorporated within the operational program. Provision shall be made for the suppression of redundant numbers on memory dumps. Provision shall be made for the dump of the memory of peripheral processors such as the SPBs. Dumps shall be obtainable both online and offline. Online dumps shall be time segmented in order to preclude interference with the operational program.

3.9.2.1.5 Program Debugging Aids.- Program debugging aids loadable from the peripheral data storage media or card reader are required. They shall include full and selective program tracing, snapshot, and breakpoint testing routines as a minimum. The input/output typewriter shall permit entry of commands to initiate program debugging aid loading. Snapshot shall be obtainable both online and offline in all RDS-500 and SPBs.

3.9.2.2 Maintenance and Diagnostic Programs.- Offline maintenance and diagnostic programs to detect and isolate errors or faults and to verify correct operation of all internal and external interfaces and error logic, excluding only the DG I/O PCBs, are required. Such programs shall be loadable from either the peripheral data storage media or card reader. The input/output typewriter that is configured to the offline CP shall permit entry of commands to initiate maintenance and diagnostic program loading. The disk diagnostic programs shall be loadable from magnetic tape.

3.9.3 Test Programs

The test programs and scenarios developed to demonstrate that the DARC performs the functions required by this specification shall be provided. The test programs shall be identified and described in the qualification and acceptance test plan. All programs and documentation required to update or change scenarios shall be provided.

3.10 GENERAL REQUIREMENTS

All DARC system equipment shall conform to the requirements of FAA-G-2100/1, 3, 4, 5, and subsidiary documents referenced therein except for off-the-shelf equipment. Each item of off-the-shelf equipment shall conform to those workmanship and quality standards of its manufacturer in effect on the date of the request for proposals and all requirements stated in this specification. However, all DARC equipment including off-the-shelf equipment shall meet the requirements as specified in the following paragraphs. The DARC peripheral off-the-shelf equipment (teletypewriter, line printer, card reader, tape and disk drives including their power supplies) shall be required to meet only the requirements of paragraphs 3.10.7 System Grounding, 3.10.8 Conducted and Radiated Interference, and 3.10.17 AC Power Consumption.

3.10.1 General Construction

Structural strength and rigidity of equipment units and cabinets shall be such that handling for loading, shipping, unloading, and setting into position for installation shall not result in any permanent set or deformation sufficient to impair the appearance of the cabinets, equipments, or units; or to interfere with ease of maintenance, removal of units or components, ventilation, and operation of access doors. The structural strength and rigidity of cabinets shall be independent of any strength and rigidity furnished by access doors. The design shall provide accessibility for maintenance and repair or replacement of units, components, and circuits. Each subassembly shall be removable from the cabinets without requiring the partial or complete removal of any other subassembly. All cabinet assemblies shall be designed so that it shall not be necessary to bolt or fasten down the equipment. Adjustable leveling pads shall be provided at each corner of the cabinet base, having sufficient travel to unload casters

underneath the cabinet when casters are used. All access doors shall be mounted by slip-pin hinges so that doors may be removed easily from the cabinet. Panels and chassis shall be adequately braced and of sufficiently small size and weight not to exceed 50 pounds to permit removal and replacement by one unassisted technician. Removal of units for maintenance or repair or for interchanging of units shall not cause any permanent set or deformation to the cabinet or to the units. Where equipment cabinet lifting devices, such as hooks or rings, are installed for convenience in handling, such devices shall be replaced by the contractor with suitably painted cap bolts to be installed after removal of hooks or rings. All cables and wires, harnessed or single, shall be protected against chafing, and such protection shall be independent of the individual wire or cable insulation or jacket. All surfaces of items on the front of the panels shall be at chassis ground potential.

Cabinets shall be designed for installation side-by-side with no open space between cabinets. Equipment cabinets located in the equipment room shall be no greater than 72 inches (183 centimeters (cm)) in height (excluding travel of leveling pads), 37 inches (92 cm) wide, and 32 inches (81 cm) deep. These dimensions exclude cable ducts and input/output connectors. Such external protrusions may extend an additional 2 inches (5.1 cm) normal to the cabinet surface. Maximum floor loading shall be less than 200 pounds per square foot. The DARC equipment located in the equipment room, necessary to accommodate 60 displays shall not require more than 150 square feet excluding aisle space. DARC equipment, located in the equipment room, necessary to accommodate up to 72 displays shall not require more than 200 square feet excluding aisle space. The data entry keyboard to be located in the operation room shall require no more than 12 square feet of floor space and shall be so constructed as to permit data entries to be made by an operator sitting in an executive-type chair. The design and construction of the DARC cabinets shall be subject to Government acceptance.

3.10.1.1 Color and Texture of Finishes.- The finish of all exposed covers, doors, shells, etc., in the equipment room shall be baked vinyl base paint. Accent panels shall be in contrasting colors. The basic color and accent panel colors shall be as specified from the colors normally offered by the manufacturer. A process sheet describing the application and inspection techniques to be used for finishing all control panels shall be provided as a part of the design data. In the operating area, the front face and edges of exterior and interior front panels and panel doors, and the exterior surfaces of console cabinets, portable cabinets, and all other exterior metallic enclosures, including the doors thereof and exterior and interior trim strips, shall be finished by applying one or more uniform spray coats of a baking primer, which shall be mixed, applied, and baked in accordance with FAA-STD-012; such baking shall be followed by

application of one or more uniform spray coats of an ovencured coating compound, plastomeric, ultra-low gloss, class A in accordance with TT-C-001558 (FAA-Trans) color No. 30372 of Federal Standard 595.

3.10.2 Cabinet Ventilation and Cooling

All blowers, vents, and cooling equipment necessary for the ventilation and cooling of equipment shall be provided. Each cabinet requiring forced ventilation shall contain its own blower system and shall require no external ducts. The equipment shall not overheat nor develop hot spots exceeding 55 degrees Celsius (C) with access doors and plates open for servicing for up to 8 hours. Ventilation air intake shall be from the bottom of the cabinet; the cabinet design shall allow air intake from either floor level or, by simple removal of cover plates or baffles from below a false floor. This dual configuration provides the Government with the choice of an air intake option in the operational environment at any time in the future. Input air filters shall be provided which shall accommodate either method of air intake for all equipment cabinets and shall be removable from the outside (exterior) of the equipment cabinets without the necessity of opening access doors. Ventilation exhaust outlets shall be designed so that foreign objects dropped from above cannot enter the cabinet through exhaust outlet openings.

3.10.2.1 Overheat Warning.- Thermal warning devices shall be provided in each separate cabinet to indicate when the temperature exceeds a normal operating temperature; e.g., 115 degrees Fahrenheit (F) plus or minus 5 degrees Fahrenheit. A warning indicator readily visible from the cabinet exterior shall be provided on the cabinet. In addition, the overtemperature condition shall be reported and displayed at the SMMC.

3.10.3 Castings

All castings shall be sound, dense, and free from casting defects. Casting material shall be of a hardness sufficient to preclude deformation from cabinet loading.

3.10.4 Dissimilar Metals

Dissimilar metals indicating an electrolytic potential difference greater than 0.4 volt (V) when immersed in a 3 percent sodium chloride solution shall not be used in intimate contact unless protected against electrolytic corrosion with approved protective methods and materials.

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3.10.8 Conducted and Radiated Interference

Equipment provided shall neither be adversely affected by the operation of other equipment installed in the Government facilities nor shall DARC equipment be a source of interference to the operation of other equipment installed in the Government facilities. If requested, access shall be given, to any or all of the facilities in which DARC is to be installed, for the purpose of making measurements of the electromagnetic radiation environment at those facilities. The Government does not guarantee that all facilities shall have the same electromagnetic environment nor does it guarantee that all facilities of the same type (e.g., ARTCCs) shall have the same environment.

3.10.9 Cable Lengths

The design of DARC shall meet system performance requirements when operating with cable lengths of the following limits:

a. Three hundred feet between equipment located in the ARTCC operating room spaces and equipment located in the equipment room spaces of the ARTCC.

b. One hundred twenty-five feet between DARC output interface equipment in the equipment room and the display generator units.

c. Three hundred feet between DARC equipment and the data receiver groups.

d. One hundred feet for interconnections between DARC units other than covered by item 3.10.9a except units normally abutted with interconnections required through cabinet sides.

3.10.10 Components and Materials

Except for off-the-shelf equipment, selection of components and materials shall be in accordance with FAA-G-2100/1, 3, 4, and 5. Off-the-shelf equipment may employ components or materials not in accordance with FAA-G-2100/1, 3, 4, and 5 except that the interchangeability requirements of par. 1-3.14.3 of FAA-G-2100/1 shall apply.

3.10.11 Service Conditions

Equipment herein shall perform in accordance with the requirements of this specification under the service conditions of par. 1-3.2.23 of FAA-G-2100/1 unless specifically excluded herein. Ambient condition range shall be environment I of par. 1-3.2.23. The normal ambient temperature of the environment in which the equipment shall be installed shall be 22 degrees Celsius. Design center values and range of the primary power source shall be as follows:

AC Line Parameter	Service Condition Range
120 V design center	108 V to 132 V
208 V design center	187 V to 229 V
60 hertz design center	57 to 63 hertz

3.10.12 Electrical Service Conditions, Transient State

All DARC equipment including off-the-shelf equipment shall perform their specified functions in accordance with the requirements of pars. 1-4.11, 1-3.3.4, and 1-3.3.5 of FAA-G-2100/1 pertaining to ac power source transients. No false operational or output signals shall be generated by transients within the defined limits or by inrush currents caused by the DARC systems.

3.10.12.1 Startup **Surges.-** The peak inrush current during startup shall not exceed five times the normal peak operating current. The duration of the inrush current shall not exceed 8.0 seconds where the duration is defined as the time from input power application to the time at which the power returns to its steady state.

3.10.13 **Off-the-Shelf Equipment** Requirements

The off-the-shelf equipment shall perform in accordance with the requirements of this specification on a continuous unattended basis under the following service conditions, in lieu of par. 1-3.2.23 of FAA-G-2100/1:

Operating (Power On)

a. Altitude above sea level 0 - 7,000 feet (ft.).

b. Temperature (cabinet intake air temperature) 50 - 90 degrees Fahrenheit.

c. Relative humidity 20 - 80 percent.

d. NO direct air conditioning shall be required.

Product improvements to off-the-shelf equipment incorporated by the vendor following proposal submission may be included in all units delivered. All units delivered shall be procured from the vendor in one lot and shall be of the same form, fit, and function. Off-the-shelf equipment shall meet all requirements of this specification. Testing shall be conducted in accordance with requirements of this specification to verify compliance with all requirements of this specification.

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120 V design center	108 V to 132 V
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a. Add AWG-28, par. 5.1.1.

b. Add the following to table I of par. 5.1.1.2:

Size AWG	Diameter Inches	Elongation Min/Max Percent
28	0.0126	12/33

c. After the fifth sentence of par. 5.1.2 add: For AWG-28, the stripping force shall be 0.5 to 2.5 pounds.

d. Add the following to table II of par. 5.3.2:

Size AWG	Diameter Inches	Minimum No. Turns (a) Modified	(b) Conventional
28	0.0126	7 stripped insulated	7 stripped

e. Add the following to table III of par. 5.6.1:

Size AWG	Diameter Inches	Minimum Strip Force (pounds)
28	0.0126	4

f. Add the following to table IV of par. 5.6.3:

Size AWG	Wire Wrap Diameter Inches	Current to Be Used (AMPS)
28	0.0126	2.0

g. A manual wirewrap tool and a manual wire unwrap tool shall be provided with each equipment that contains solderless, wrapped electrical connections.

3.10.15.2 Specification **FAA-G-2100,** Supplement **4.-**

a. Add to paragraph 1.2: MIL-STD-1130, Connections, Electrical, Solderless Wrapped dated 12 November 1965.

b. Add to paragraph 9: ASTM-B-224, Standard Classification of Coppers.

3.10.16 Cable Entrance and Exit Locations

Units of DARC requiring direct connection to DGUs shall have all such cable entrance and exit locations at the top of the DARC equipment cabinets. Units of DARC requiring connection to DRGs shall also have all cable entrance and exit locations at the top of the DARC equipment cabinets. Interconnections between DARC cabinets may enter and exit through adjacent sides of equipment cabinets if they are physically connected. Otherwise, cabling shall be arranged to run underneath a false floor. Alternate installation provisions may be required for two facilities, FAA Technical Center and Houston, where false floors are not installed. Other than for the exit and entrance points of cables, the configuration of all equipment units shall be identical. All cables, cable connectors, and terminal boards required for factory and site testing and installation of the equipment shall be provided. This shall include any special purpose test cables or card extenders required for routine maintenance. Cable entrances and exits shall be designed to enable routing of the cables between units for accessibility and for noninterference with operating personnel. All cables shall be supplied with connectors installed. Any special tools required for cable fabrication shall be furnished as special test equipment. Connectors required to interface DARC with the GPOs and GPIs shall be GFE.

3.10.17 AC Power Consumption

The total power consumption shall not exceed 40.0 kilovoltamperes (kVA) for a DARC system capable of processing data for 60 displays corresponding to 10 active display generator units and 2 spare display generator units.

3.10.18 Noise Level Limits

The design and construction of DARC shall be such that the noise level limits of the hardware (excluding the peripheral) shall meet the following requirements:

Frequency Bands (Hz)								
20-75	75-150	150-300	300-600	600-1200	1200-2400	2400-4800	4800-9600	9600-20000
90	82	73	66	63	60	58	57	56

Noise levels are expressed in decibels (dBs) with a referenced pressure of 0.0002 dynes per square centimeter. The noise levels shall be measured 6 feet from the exterior surface of the equipment at a point from 3 to 5 feet above the floor. The noise level limits shall apply with the equipment configured to receive below-the-floor cooling.

3.10.16 Cable Entrance and Exit Locations

Units of DARC requiring direct connection to DGUs shall have all such cable entrance and exit locations at the top of the DARC equipment cabinets. Units of DARC requiring connection to DRGs shall also have all cable entrance and exit locations at the top of the DARC equipment cabinets. Interconnections between DARC cabinets may enter and exit through adjacent sides of equipment cabinets if they are physically connected. Otherwise, cabling shall be arranged to run underneath a false floor. Alternate installation provisions may be required for two facilities, FAA Technical Center and Houston, where false floors are not installed. Other than for the exit and entrance points of cables, the configuration of all equipment units shall be identical. All cables, cable connectors, and terminal boards required for factory and site testing and installation of the equipment shall be provided. This shall include any special purpose test cables or card extenders required for routine maintenance. Cable entrances and exits shall be designed to enable routing of the cables between units for accessibility and for noninterference with operating personnel. All cables shall be supplied with connectors installed. Any special tools required for cable fabrication shall be furnished as special test equipment. Connectors required to interface DARC with the GPOs and GPIs shall be GFE.

3.10.17 AC Power Consumption

The total power consumption shall not exceed 40.0 kilovoltamperes (kVA) for a DARC system capable of processing data for 60 displays corresponding to 10 active display generator units and 2 spare display generator units.

3.10.18 Noise Level Limits

The design and construction of DARC shall be such that the noise level limits of the hardware (excluding the peripheral) shall meet the following requirements:

Frequency Bands (Hz)								
20-75	75-150	150-300	300-600	600-1200	1200-2400	2400-4800	4800-9600	9600-20000
90	82	73	66	63	60	58	57	56

Noise levels are expressed in decibels (dBs) with a referenced pressure of 0.0002 dynes per square centimeter. The noise levels shall be measured 6 feet from the exterior surface of the equipment at a point from 3 to 5 feet above the floor. The noise level limits shall apply with the equipment configured to receive below-the-floor cooling.

a. Part I, Program **Status.-** Part I shall include a narrative of work progress during the reporting period and status of design, fabrication, and test of each DARC system.

b. Part II, **Schedule.-** See item 3.11.1.1.1d2(a).

c. Part III, Problem **Areas.-** Part III shall include the discussion and solution or progress toward solution of special problem areas.

d. Program Plan and Performance **Schedule.-** The initial management reports shall also include the information listed below; changes and updates to this initially submitted information shall be furnished in succeeding reports.

1. Program **Plan.-** Submit an overall plan designed to encompass every aspect in the planning, design, documentation, fabrication, quality control, production, factory tests, delivery, installation, provisioning, and warranty service.

2. Program Performance Schedule and Control **Procedures.-** Provide a detailed work breakdown structure and program performance schedule(s) (with supporting narrative explanation) that reflects all of the significant activities/events, with related appropriate time phasing of each element of the work breakdown structure that must be accomplished to assure successful completion of the DARC system's program. As a minimum, the following elements shall be included:

(a) Program schedule in bar chart/milestone format, divided into three main efforts as follows: prototype design, presubmission test and evaluation of prototype, and production. All subcontract efforts shall be integrated into the schedule.

(b) Subcontractor schedule/listing, components they shall supply, including critical items, their lead times, and methods of management control of the subcontractors.

(c) Explain in detail the control procedures intended to be exercised to assure expeditious completion of all activity related to the program and/or timely updating of the performance schedule. Include manpower resources, by numbers and types of skills required, for each phase identified in the program schedule in item 3.11.1.1.1d2(a).

3.11.1.1.2 Management Reports During Production.- Management reports during production shall consist of three parts as follows:

a. Part I, Program **Status.-** Part I shall include a narrative of work progress during the reporting period in the areas of installation, testing, spares support, training, maintenance, and instruction books.

b. Part II, **Schedule.-** See item 3.11.1.1.1d2(a).

c. Part III, Problem **Areas.-** Part III shall include a discussion and solution or progress toward a solution on special problems in both the support and production functions.

3.11.1.2 System Design Data.- The design data shall be organized to reflect the approach to the total system design and shall be organized in a logical sequence to reflect the hardware and software design approach. All pages shall be sequentially numbered within major sections or subsections. This submission of design data shall not be used to produce modifications or alternatives to details of this specification or a change in the scope of the contract. The design data shall include all elements of the equipment to be supplied for this specification and any addenda thereto, together with all interfaces with other equipment. A summary of equipment operational characteristics shall be included.

3.11.1.2.1 System Description.- The system design data shall include a description of the overall system and each subsystem detailing the interaction and operational capabilities necessary to meet functional requirements.

3.11.1.2.2 Block Diagram.- A complete set of equipment block diagrams shall be provided by the contractor. The block diagrams shall show the general operational, electrical, and physical relationships of the equipment elements.

3.11.1.2.3 Information Logic Flow Diagrams.- These diagrams shall show the detailed logical, operational, and functional relationships of the equipment elements. Symbology used in these diagrams shall be fully explained in the basic document.

3.11.1.2.4 Input/Output Details.- Data which consolidates all equipment interfaces and input/output characteristics are required. These shall include: transmission line characteristics, signal characteristics and limits, timing diagrams, message structure and formats, and power requirements. These data shall include all major intrasystem as well as external system interfaces. All human/machine interfaces shall be provided including message formats, contents, etc. (see par. 3.2.1.1).

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a. Part I, Program **Status.-** Part I shall include a narrative of work progress during the reporting period in the areas of installation, testing, spares support, training, maintenance, and instruction books.

b. Part II, **Schedule.-** See item 3.11.1.1.1d2(a).

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3.11.1.4 Equipment and Computer Program Test Procedures.- The test procedures shall be comprehensive documents including all details necessary to assure that test procedures and testing thereto shall satisfactorily demonstrate equipment and system compliance with all functional, environmental, electrical, mechanical, reliability, maintainability, throughput, and response time requirements as contained in this specification. Each test section of the test procedure shall reference the specified requirements of this specification which are being verified by the test described. The Government reserves the right to witness any and all tests and to require additional testing as may be needed to verify compliance with this specification. These procedures and data sheets shall comply with all requirements of FAA-STD-016 and FAA-STD-018.

3.11.1.5 Final Test Reports.- The test report shall contain a complete description of the test results. The test report shall contain, as a minimum, the information specified below.

a. Copies of the test data sheets.

b. Performance indicators of each equipment under test and whether the equipment meets the system limits.

c. Functions that were tested.

d. Information as to whether the results of the test are in agreement with the required reliability of the unit or system.

e. Records of any engineering changes found necessary to correct design deficiencies.

f. Copies of all discrepancies noted during the test with the Government accepted dispositions.

g. Copies of all deviations from the approved test procedures required during conduct of testing.

3.11.1.6 Site Preparation Reports.- The site preparation report shall be used by the Government to prepare the site for installation of the contractor's equipment and to perform necessary services not required of the contractor. Therefore, all requirements to prepare the site for installation of the equipment shall be included. The report shall include, but not be limited to, the following:

a. Definition of power requirements, circuit breaker panels, physical space, and air conditioning requirements to be furnished by the Government for each deliverable unit. Such information as starting surge current data, circuit breaker

requirements, and any other information needed for the Government to prepare for the equipment installation shall be included.

b. Definition of cable and connector requirements for the complete installation.

c. Definition of contractor's office equipment and space requirements to be furnished by the Government during the installation and checkout period.

d. Identification of requirements for Government and other contractor's services and test equipment, if any.

3.11.1.7 Installation Documents.- The installation documents shall contain all necessary information required by trained technicians and engineers to correctly install the equipment and initiate its operation.

3.11.1.8 As-Built Installation Drawings.- Site installation drawings, prepared in accordance with FAA-STD-002 covering all equipment installed and in place for each DARC system shall include, but not be limited to, power distribution cabling, signal and control cables, ground systems, floor plan, and equipment identification.

3.11.1.9 Interface Control Documents.- Interface control documents shall describe each external interface including equipment and software interfaces. The level of detail shall be sufficient to completely describe DARC interface characteristics, sequences, and formats for interfacing with the external equipment and software.

3.11.1.10 System Instruction Manual.- The DARC system instruction manual, prepared in accordance with FAA-D-2494, parts 1 and 2, shall include sufficient level of detail on the hardware and software and their interaction to enable thorough understanding of all DARC functions. The manual's organization, content, and level of detail shall be such that DARC system problems and problems concerning the interface with external systems and devices are sufficiently treated to facilitate system level troubleshooting.

3.11.2 Hardware Documentation

This section of the specification delineates the hardware documentation requirements of the DARC.

3.11.2.1 Reliability and Maintainability Reports.- Reliability and maintainability reports shall contain a complete detailed analysis of the equipment reliability and maintainability predictions and models, and a summary of the reliability program required by this specification.

3.11.2.2 Equipment Instruction Books, Engineering Drawings, and Graphic Symbols.- Equipment instruction books shall be prepared in accordance with FAA-D-2494, parts 1 and 2, in accordance with the contract schedule. Engineering drawings shall be in accordance with MIL-D-1000. Graphic symbols for digital logic diagrams shall be in accordance with FAA-STD-010.

3.11.2.3 Index of Drawings and Technical Memoranda.- An index shall be maintained of all drawings and technical memoranda produced in connection with design, fabrication, and test of the equipment.

3.11.2.4 Provisioning Technical Documentation.- Provisioning documentation shall be prepared in accordance with FAA-G-1210.

3.11.3 Software Documentation

Software documentation shall include all documentation necessary for FAA to use, maintain, and modify all deliverable DARC computer programs.

3.11.3.1 Operational Program Documentation.- The operational program documentation shall include a program description manual and an operator's manual. In addition, complete listings and card decks, or preferably, card images on tape for the computer programs shall be provided. The listings shall include appropriate comments to functionally describe the code.

3.11.3.1.1 Program Description Manual.- The program description manual shall describe the functional requirements of all DARC systems' operational programs and their relationships to the hardware and to the interfaces between other components of the system. The manual shall include sufficient diagrams and flow charts to clearly describe how the computer programs satisfy the requirements of this specification. The manual shall provide an overview of all program routines and reference other related program documentation. The program description manual shall also describe in detail the functional specifications, interfaces, flow charts, and instruction coding for each program routine described. The PDM shall be prepared in accordance with the requirements of the contractor-generated, FAA-approved DARC software documentation standard.

3.11.3.1.2 Operator's Manual.- The operator's manual shall provide an operator with an understanding of the DARC systems configuration, and with all of the information needed to operate the operational programs. The manual shall clearly describe the relationship of the manual to other program documentation, describe the location and function of all operator controls, describe the use of all data processing equipment peripherals, and provide detailed operating procedures for both normal operation and during failure modes.

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3.11.3.3 Test Program User's Manual.- The user's maintenance manual shall include instructions and procedures for all test programs developed as a result of this specification. This manual shall include a program listing, initiation and intervention procedures, a complete list of possible operator or error halts, all actions required of the operator or test personnel, complete listings, and source code. Listings shall include appropriate comments to functionally describe the code.

3.12 INTEGRATION OF DARC INTO NAS STAGE A

The DARC system shall be integrated into the NAS Stage A ARTCCs. Operational narrowband backup service shall be insured through all periods of system integration. In addition, the special need for the FAA Technical Center to be able to provide hardware and software support for basic DARC, R-2508, and upgrade DARC during all stages of system integration shall be satisfied. This requirement to conduct system integration on a non-interfering basis shall be deemed satisfied on condition that DARC service interruptions are limited in extent to no more than one Government-selected, 8-hour interval per day. The design of the DARC interfaces shall be compatible with the applicable interfaces of the ICDs listed in par. 2.3. The design of the DARC interfaces shall not require any changes to NAS Stage A equipment, interface electrical characteristics, timing sequences, message formats, or message definitions except as defined herein.

4.0 QUALITY ASSURANCE PROVISIONS

This section sets forth the general requirements for tests and inspections which are to be performed by the contractor in order to determine compliance with the requirements of this specification. The provisions of FAA-G-2100/1, section 1-4 shall apply.

4.1 INSPECTION AND QUALITY ASSURANCE - GENERAL

A quality control program shall be provided and maintained in accordance with FAA-STD-016 and a computer software quality program shall be provided and maintained in accordance with FAA-STD-018. All tests and inspections shall be subject to Government inspection. The term "Government inspection" as used in this specification means that an FAA representative shall witness the testing and inspection, and shall carry out such visual and other inspection as deemed necessary to assure compliance with contract requirements.

4.2 INSPECTION AND TEST ACCEPTANCE CRITERIA

Acceptance of material shall be determined by Government inspectors after acceptance by the quality assurance personnel using predetermined test procedures, quality standards, and factory inspection and test parameters approved under provisions of FAA-STD-016 or as otherwise defined in the contract.

4.3 QUALIFICATION AND ACCEPTANCE TESTS

The approved version of the qualification and acceptance test plan shall govern the execution of qualification and acceptance tests.

4.3.1 Preliminary Tests

Preliminary tests shall be performed in accordance with the requirements of par. 1-4.3.1 of FAA-G-2100/1. The first system prepared for delivery shall be used in such tests. The quantities of DARC units in the configuration for this test shall be as specified in the contract.

4.3.2 Design Qualification Tests

Design qualification tests of new DARC upgrade hardware designs shall be in conformance with par. 1-4.3.2 of FAA-G-2100 and the following paragraphs in this specification. The first system prepared for delivery shall be used in such tests. The quantities of DARC units in the configuration for this test shall be as specified in the contract. Any portions of the design qualification tests requiring a larger configuration than the first system for conclusive results shall be performed on a subsequent deliverable system of adequate size.

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be more efficient to perform qualification of some areas on a portion of the DARC system. The test plan shall consider the schedule and technical tradeoffs in this area and propose the more efficient plan to complete functional design qualification in all areas.

4.3.3 Production and Onsite Acceptance Tests

Production and onsite acceptance tests shall include first article factory acceptance tests, factory acceptance tests, and DARC system onsite acceptance tests. The qualification and acceptance test plan shall describe the specific tests to be performed in each category. Factory acceptance tests shall be performed for each deliverable DARC system. Successful completion of such tests shall be the basis for preliminary acceptance of the system by the Government. DARC system onsite acceptance tests shall be performed on each deliverable DARC system following its installation at the ARTCC or other facility. Successful completion of such tests shall be the basis for final acceptance of the total installation, including equipment, by the Government. Special attention shall be given in the onsite acceptance tests to demonstrate correct external interface operations and compliance with all requirements. Test requirements to be covered in each of the categories shall include, but not necessarily be limited to, those defined in the following paragraphs.

4.3.3.1 First Article Factory Acceptance Tests.- Factory acceptance tests as defined in the approved qualification and acceptance test plan shall be performed on the first DARC system prepared for delivery. In addition, the subsystem shall undergo a 72-hour test at the contractor's plant before factory acceptance can be given. The DARC equipment shall be operated continuously for the 72-hour test at design-center values of temperature and power in order to demonstrate stability of operation. All observations of malfunctioning or instability during this test shall be recorded on test data sheets. During the operating period the DARC equipment shall be loaded with representative input data producing not less than 50 percent of the display data loads defined in table 3-1 herein. During the operating period the DARC system's data entry keyboard shall be used to enter data messages changing the PVD and system parameters at hourly intervals. A more comprehensive test to include the use of input/output peripheral equipment shall be performed at 8-hour intervals. All system adjustments shall be made prior to the start of the test and no further adjustments shall be allowed for the duration of the test. During the last 30 minutes of the test, two simulated power failure tests shall be made independently. The first test shall be made by interrupting all ac power to the system for a period of at least 15 seconds. When power is restored, the equipment shall resume proper operation without any equipment adjustments via a manual restart action. The second test shall be made by interrupting the ac power to the system for a period of not more than 2.4 seconds. When power is restored, the equipment shall resume proper operation without

any equipment adjustments or manual intervention. A plan for conduct of the 72-hour test shall be included in the qualification and acceptance test plan, which shall include the proposed pass/fail criteria to be used. This criteria should be consistent with the specified reliability of the DARC system.

4.3.3.2 Factory Acceptance Tests.- Factory acceptance tests as defined in the approved qualification and acceptance test plan shall be performed on all subsequent DARC systems. Each system shall be subjected to the test required by par. 4.3.3.1, except that the period for the stability test shall be reduced to 48 hours.

4.3.3.3 Onsite Acceptance Tests.- Upon completion of DARC equipment installation at an ARTCC or other facility, as named in the contract, that section of the approved qualification and acceptance test plan together with approved test procedures detailing onsite acceptance tests shall be conducted. Operational narrowband backup service shall be insured through all periods of onsite acceptance testing. In addition, the special need for the FAA Technical Center to be able to provide hardware and software support for basic DARC, R-2508, and upgrade DARC during all stages of onsite acceptance testing shall be satisfied. This requirement to conduct acceptance testing on a non-interfering basis shall be deemed satisfied on condition that DARC service interruptions are limited in extent to no more than one Government-selected, 8-hour interval per day. Onsite acceptance tests shall verify DARC operation in compliance with all design requirements. These tests shall be conducted in three stages. The qualification and acceptance test plan shall use the following general requirements for each stage to develop a complete onsite acceptance test plan.

4.3.3.3.1 Stage 1.- Stage 1 shall verify DARC system integrity prior to interfacing with any site equipment. Stage 1 shall be successfully completed before stage 2 can be started.

4.3.3.3.2 Stage 2.- Stage 2 shall be an integration test to be conducted after the DARC system is integrated with the site facilities. To minimize interference with the normal facility operations, this test shall be conducted with the DARC system in a test configuration and each interface shall be thoroughly checked out one at a time. DARC system performance shall be demonstrated utilizing the operational computer program. DARC system performance and stability shall be demonstrated before proceeding into stage 3.

4.3.3.3.3 Stage 3.- This stage shall use operational PVD to demonstrate complete site adaptation. During this test all functions and representative combinations of functions shall be exercised. As many interfaces shall be active for this demonstration as facility operational requirements shall permit, but not less than one of each type of interface shall be used.

4.4 INSPECTION OF PREPARATION FOR DELIVERY

Inspection of preservation, packaging, packing, and marking of material for shipment and storage shall be conducted to assure conformity with the requirements of section 5.0.

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5.0 PREPARATION FOR DELIVERY

5.1 SUBSYSTEM DELIVERIES

All material and equipment required for the DARC systems installation shall be shipped to each site.

5.2 SPARE PARTS DELIVERIES

All spare parts shall be marked, packaged, and packed for delivery in accordance with the requirements of MIL-E-17555. Site spares shall be packaged and packed per level C requirements. Parts peculiar and depot spares shall be packaged per level A requirements and packed per level C requirements (FAA-G-1375).

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FAA-E-2530h
July 1, 1985
SUPERSEDING FAA-E-2530g
dated July 1, 1983

DEPARTMENT OF TRANSPORTATION

FEDERAL AVIATION ADMINISTRATION

SPECIFICATION

DIRECT ACCESS RADAR CHANNEL
(DARC)